Popular Astronomy

Vol. L, No. 7 AUGUST, 1942 Whole No. 497

The Sixty-Eighth Meeting of the American Astronomical Society

By DEAN B. McLAUGHLIN

On the invitation of Yale University, the American Astronomical Society held its sixty-eighth meeting at New Haven, Connecticut, Friday to Sunday, June 12-14, 1942. The last previous meeting there was more than eleven years earlier.

The writer came up on a through train from Philadelphia on Thursday afternoon. The air-conditioning seemed to have failed on that day of all days, with the temperature and humidity both in the objectionable parts of their respective scales. At New York the monotony of the journey was relieved when Drs. Pierce and Stewart of Princeton boarded the train. It turned out that Dr. Burns was on the same train, but in a different car, where the air-conditioning was working too well. The average was good, but we derived small comfort from it.

On arrival at New Haven we went to the Hotel Taft where a majority of the visiting astronomers stayed. Some lived at the Bishop a block away. Members took their meals in the dining room of the Taft or in any of several restaurants in the neighborhood.

It was soon impressed upon us that we were involved in a war. Signs in conspicuous places pointed the way to air raid shelters, and guests were cautioned to keep window blinds down at all times after dark when any lights were on.

No events for the Society were scheduled for Thursday evening, but the Committee on Publications met at the Yale Observatory and decided on some of the future policies for Society publications. This excursion to the observatory incidentally gave an opportunity to view the effects of the "dim-out." In spite of the fact that the observatory is surrounded by the city, the sky was fairly dark. The feeble lighting of the streets even in the down-town section was rather wierd to a newcomer, and automobiles travelling at twenty miles per hour, with only parking lights, seemed pretty hazardous. However, Dr. Goedicke explained that the lights on his car had been just about that way for a couple of years anyway, so the new regulations were no trouble at all.

For the sessions and for social gatherings in conjunction therewith, the University made available the auditorium and the spacious lounge in the Sterling Law Buildings. In these comfortable surroundings we

made ourselves very much at home. The meeting place was about a ten-minute walk from the Hotel Taft. Dr. Brouwer, Director of the Yale Observatory, Miss Barney, Miss Jenkins, and the rest of the staff had evidently thought of everything in the shape of facilities and comforts for the Society. All arrangements were perfect except for the weather, which reminded the writer of Sumatra.

The first scheduled event was the Teachers' Conference,—now a full-fledged part of the Society's meetings,—which was held beginning at 9:30 Friday morning. The subject was "The Teaching of Navigation," and the discussion was led by Drs. John Q. Stewart and Newton L. Pierce. A number of charts, instruments, and materials used in the teaching of navigation were on exhibition in the lounge. Members of the Council for the most part missed the discussion, as the Council meeting ran concurrently.

The first general session of the Society was called to order by President Stebbins at two o'clock Friday afternoon. With the Society standing, the list of members who had been lost through death during the past year was read:

George C. Blakslee
Heber Doust Curtis
John Stanley Plaskett
Arthur Bambridge Wyse

At this time we also learned with sorrow of the death of Mrs. Frederick Slocum, who had often attended meetings, and who would have been our hostess at Middletown.

The Society was officially welcomed by Dean Charles H. Warren of the Sheffield Scientific School of Yale University. His speech was something more than an address of welcome, for he gave an interesting outline of the history of astronomy at Yale. The session was then given over to the presentation of papers. The authors are now so well educated to the time limits that a goodly percentage finish even before the preliminary two-minute warning. Perhaps they took the Secretary seriously when he suggested they rehearse their papers aloud in the dome (reviving a proposal made by Dugan when he was Secretary).

Immediately after the close of the session, tea was served in the neighboring lounge. This furnished an opportunity for less technical discussions than those which had preceded, as well as for examination of the navigation exhibits.

The feature of the evening was a lecture by Dr. W. J. Eckert, Director of the Nautical Almanac Office, on the construction of the Air Almanac. He compared the four principal air almanacs (British, French, German, and American) and traced the history of our own, and its relation to the American Ephemeris and Nautical Almanac. One member later remarked that Dr. Eckert surprised the astrophysicists by proving that a lecture on such a subject could really be interesting.

The annual business meeting was held at the beginning of the Saturday morning session. The following officers were elected:

Vice-President	1942-44	J. H. Moore
Secretary	1942-43	D. B. McLaughlin
Treasurer	1942-43	Keivin Burns
Councilors	1942-45	W. J. Eckert
		E. A. Fath
		B. J. Bok

A proposed minor amendment to the Constitution was defeated by such a small margin that the President and Secretary had to consult the Constitution before they could be sure whether it had won or lost. Amendments to the By-Laws, concerning the relations of the *Astronomical Journal* and *Astrophysical Journal* to the Society, were adopted.

A nominating committee was then elected. It will be the task of this group to select candidates for the annual election in 1943, which will be a presidential year. The committee consists of:

Mrs. Cecilia Payne Gaposchkin, *Chairman*
Robert H. Baker
Seth B. Nicholson.

The remainder of the morning session was devoted to the presentation of papers. At noon the meeting adjourned for the taking of the group photograph. After first assembling at the wrong place the crowd was herded over to the right one. For several minutes they were betting even money that the photographer would be run over by a street-car or a taxi before he snapped the picture, but he came through without a scratch. The task of arranging the group would be facilitated by engaging the services of a good top-sergeant for the occasion.

A short meeting of the Council was held after luncheon, and the final session for papers followed. The program was completed at 4:30 without difficulty and to the satisfaction of all. In the three sessions, 32 papers were presented and one was read by title.

Beginning soon after 4:30 a number of members were treated to a tour of University buildings, under the guidance of students. The Yale campus is a very picturesque one, with its mixture of Georgian and "College Gothic" architecture. Yale has a distinctly "old-world" look about it, which is a pleasing change from the factory-like buildings of some of our universities.

The Society dinner was held that evening at Wilcox's restaurant at the Savin Rock amusement park, beside the bay at West Haven. What with the reduced number of available automobiles, on account of gasoline rationing, some members of the Society had their first street-car ride in several years on the way to or from Wilcox's. When we got there we admired the view of the bay from the upstairs dining room, and eagerly scanned the water for a glimpse of an axis submarine's periscope, but in this latter we were disappointed.

There was a choice of shore dinner for those who thought they could "take it," or steak dinner for those who preferred it. Comments after-

wards were all in favor of having the Society dinner at some such place outside the usual "theatre of operations" of the meeting.

After-dinner speeches were made by Burns, Mrs. Gaposchkin, Atkinson (who has come over from Greenwich), and Dr. William Lyon ("Billy") Phelps. The speakers had to compete with the sound of the roller-coaster until the outside door was closed. The war caused a little discomfort on this occasion, for it was necessary to close the "black-out" shutters as darkness set in. These not only kept the light from getting out, but prevented the breeze from getting in.

Dr. Burns talked on the work of astronomers in the first World War (since it seemed advisable to be silent about what they were doing in this one). Dr. Atkinson told of amusing incidents in connection with the disposal of unexploded bombs in England, and Mrs. Gaposchkin spoke on the dedication of the new observatory at Tonanzintla. His impressions of the transit of Venus in 1882 were the main topic of Dr. Phelps' talk, which was closely interwoven with his characteristic humor. Miss Harwood then presented a resolution of gratitude to our hosts, and the meeting adjourned. Some returned at once to the hotel, but it is reported that others indulged in the various frivolous pastimes which were available at the neighboring amusement park.

Sunday was devoted to almost purely social functions. An "open house" and inspection of the Yale Observatory was followed by a picnic luncheon on the observatory grounds. Gathering clouds obligingly refrained from spilling their contents until after the luncheon was over, but then they did so with considerable vigor.

When the rain had nearly ceased, an expedition to Middletown was organized. Members of the Yale Observatory staff contributed their cars and their services as drivers. This is especially deserving of honorable mention, in view of the rationing of gasoline. Thanks are due also to the rationing board for granting an extra allowance for the use of the Yale astronomers in connection with the meeting.

On arrival at the Van Vleck Observatory at Middletown, the visitors were greeted by Dr. Slocum and the staff of the observatory. Tea was served and the observatory was open for inspection. We were incidentally able to watch a review of a local military unit on the athletic field below the observatory. The departure of the guests marked the completion of the disintegration of the group that had attended the sixty-eighth meeting.

The writer spent two and one-half additional days at New Haven, as the guest of Dr. and Mrs. Goedicke and of the Yale Observatory. This stay afforded an opportunity for carrying out in leisurely fashion a few of the post-meeting jobs of the Secretary. He had an ulterior motive in staying, for West Rock and East Rock are of considerable geological interest.

The meetings of the Council on this occasion were less strenuous than

at some recent meetings. Twelve new members were elected to the Society. These additions, in conjunction with losses through death, resignation, and ejection for failure to pay dues, bring the membership to 637.

Doubtless the most important action of the Council at this meeting concerned publications. The Committee on Publications recommended, and the Council approved, a procedure which may be summarized as follows. With the report of the Yale meeting, and the issuing of the list of members, Constitution and By-Laws, and index, the current Volume 10 of the *Publications of the American Astronomical Society* will be completed, and those *Publications,* as such, will be terminated. In their place, the abstracts of papers and the reports of observatories will be published in the *Astronomical Journal,* and reprints of the numbers which contain them will be distributed to the members. General accounts of the meetings will not appear in the *Journal,* but will continue to appear in POPULAR ASTRONOMY, together with the group photograph. The list of members and the Constitution and By-Laws will be issued at intervals as in the past.

The date and place of the next meeting have not been fixed specifically, because of the generally unsettled condition of the world. It is probable that the sixty-ninth meeting will be held at the customary time between Christmas and New Year.

ANN ARBOR, MICHIGAN, JULY 1, 1942.

Report of the Conference of Teachers of Astronomy at New Haven, Connecticut, June 12, 1942

By MARJORIE WILLIAMS

A conference of teachers of astronomy was held at 9:30 A.M. on June 12, 1942, in connection with the New Haven meeting of the American Astronomical Society. Dr. John H. Pitman, chairman of the Teachers Committee, presided. He reviewed the two previous meetings, held at the Yerkes Observatory and at Cleveland, and reported on the recent activities of the committee. A report from Dr. Barton was read, stating that the special committee on astronomical pronunciation has completed its work, and that a complete list of constellation and star names has been compiled, giving pronunciations and derivations. It is hoped that this entire list may be published at a future time, but at present the council has approved the publication of the pronunciations of the names of the constellations and the fifty best known stars. Attention was called to the 2 x 2 Kodaslides of various observatories which have been prepared by Dr. Swann of the Eastman Kodak Company. Dr. Mohler re-

ported that the printing of motion pictures by the McMath-Hulbert Observatory will necessarily be delayed. Dr. Smiley announced that a set of fifty 2 x 2 slides will be made at Brown University, to sell for $7.50. They will not be sold singly.

The Teachers Committee, through Dr. Pitman, brought up the question of its perpetuation, and made the suggestion that new members should be nominated from the floor at the conference, subject to the approval of the council. The term of office shall be three years. One member of the present committee shall retire this year, two next year, and two the next. Dr. Pitman announced that it is necessary for him to be the one to retire this year. Several nominations were made from the floor, and Dr. John C. Duncan was the nominee chosen by ballot. His appointment was later approved by the council, and Dr. Alice H. Farnsworth was designated as the chairman of the committee.

The program for the conference was a discussion of the teaching of Navigation. Dr. Pitman introduced this topic by reading a letter from Dr. C. C. Wylie, a member of the Teachers Committee who has visited Air Corps Training Camps to determine what the army wishes the colleges to give the men going into service. He finds that they prefer to have the fundamentals of astronomy, physics, and mathematics taught in the colleges, since the navigation will be taught in the service schools. Below are listed the points stressed by the men in charge of training aviation cadets in several different camps.

1. Familiarity with the constellations and stars.
2. A correct conception of the earth in space, and an understanding of its motions.
3. An understanding of the fundamentals of time, longitude, and latitude, including the Sumner line, with the solution of numerical problems.
4. Practice in computing until the student has obtained reasonable speed and accuracy and learned to use good forms. Practice in the use of the slide rule.
5. Practice in timing to the second with a watch, until the student can record times repeatedly without making errors of minutes.
6. Practice in the reading and construction of maps.
7. An understanding of the astronomical fundamentals of meteorology, with the inclusion of the cloud types and the cloud changes which assist in forecasting the weather a few hours in advance.
8. Correct habits of reasoning, so that the student can distinguish between scientific facts and speculation or superstition.

Many colleges, however, do have courses in navigation, and it was felt that a discussion of methods and material would be worth while. Dr. John Q. Stewart and Dr. Newton L. Pierce of Princeton University were the principal speakers. Dr. Stewart feels that the teaching of navigation in colleges is important, to give pretraining to navigators,

and to train instructors for the service schools. Also, much is to be said for retaining navigation in the curriculum after the war. He pointed out that time is not available for teaching theory, and that we must be practical and modern, and use the short methods which are used in the service schools. It is important to have uniform terminology. It is best not to divide an elementary course into marine and air navigation, but to teach the two together. To the four usual divisions of navigation: piloting, dead reckoning, celestial navigation, and radio navigation, Dr. Stewart adds sailings and problems of relative motion. Of these six, astronomy provides the background for only one, celestial navigation.

Dr. Pierce gave some practical suggestion on each of the six divisions. He feels that chart navigation is becoming more important. Bearings and distances must be plotted accurately. The problems of relative motion are more important in war than in peace, although always of great importance to the aviator. One vector diagram can be used for all problems, and Dr. Pierce finds that it is best not to tie it up with a map. Students should have practice with the sextant and the bubble octant. However, the use of a sextant with an artificial horizon is hardly worth the time it takes. The working of a great many problems is essential for both student and instructor.

Lieutenant Commander H. O'D. Hunter of Yale University was present and gave some suggestions from his teaching experience. He has found that in general liberal arts students, however brilliant, cannot do arithmetic and do not know how to be accurate. Absolute accuracy is essential if a plane is to arrive at its destination. He feels that it is necessary to learn to use the *Nautical Almanac* as it might be impossible to obtain the *Air Almanac*. He finds Ageton less confusing than Dreisonstok. The Rude Star Finder can be used to find the names of stars.

The next speaker was Colonel George W. Mixter, author of the "Primer of Navigation." He thinks that the tendency is to try to teach too much in the time available. The subject could be simplified by cutting out useless terms such as nadir, prime vertical, departure, amplitude. Piloting is more difficult than celestial navigation, and cannot be taught in a classroom. The astronomical triangle should be kept down on the earth, and the geographical positions used. Zone time should be taught. It is not necessary to teach sidereal time.

Following further remarks by Professor F. W. Keator, of the Department of Mechanical Engineering at Yale University, there was general discussion in which the following points were brought out. College courses in navigation may be unnecessarily academic, and astronomers may be demanding too great accuracy. It is not necessary to teach spherical trigonometry. An air pilot must be more skilled, more rapid, and more thoroughly trained than a marine pilot, but it is necessary to learn marine navigation as a foundation.

The question of the necessity for training women in navigation was raised. Lieutenant Commander Hunter pointed out that women have handled some of the navigation in boat races, and he feels that in the future they may be called upon to do anything for which they have the training. Women may also be used as instructors.

From informal reports given by instructors in the men's colleges as to the numbers of students taking navigation to prepare for service it was estimated that the colleges are turning out only about 3 percent of the navigators needed.

A very interesting exhibit of navigation instruments, charts, and tables was arranged through the courtesy of Yale University.

SMITH COLLEGE OBSERVATORY, NORTHAMPTON, MASSACHUSETTS.

Report Prepared by the Committee of the American Astronomical Society on Preferred Spellings and Pronunciations

The undersigned committee, appointed by the American Astronomical Society for this purpose, after careful consideration of the matter, recommends that the following be used as the spellings, pronunciations, and meanings of the names included.

GEORGE A. DAVIS, JR.,
Buffalo Museum of Science

DANIEL J. McHUGH, C.M.,
De Paul University, Chicago

SAMUEL G. BARTON, *Chairman*,
Flower Astronomical Observatory,
University of Pennsylvania

a

ā as in āle, fāte, māker, profāne.
å as in chåotic, fåtality, grådation, våcation.
ă as in băck, hăt, răndom, sănd, tăp.
ă̲ as in ă̲bhor, ă̲ccount, fină̲l, sylvă̲n, vacă̲nt.
ȧ as in ȧsk, grȧss, lȧst, pȧth, shȧft.
ȧ̲ as in ȧ̲bide, ȧ̲bound, diȧ̲dem, ideȧ̲, sofȧ̲.
â as in câre, compâre, hâre, pârent, shâre.
ä as in älms, ärm, fär, fäther, pälm.
au as in aught, caught, haul, taut (= ô).

e

ē as in bē, concrēte, dēviate, ēve, mēter.
ė̄ as in crė̄ate, dė̄linė̄ate, ė̄pitome, ė̄vade.
ĕ as in ĕnd, ĕrror, fĕrry, pĕt, tĕn.
ĕ̲ as in angĕ̲l, camĕ̲l, gospĕ̲l, jewĕ̲l, novĕ̲l.
ẽ as in lovẽr, makẽr, pẽrform, readẽr.

i

ī as in bīnd, chīld, īce, sīght, tīme.
ĭ as in bĭt, habĭt, humĭd, ĭll, pĭt.
ĭ̲ as in anĭ̲mal, charĭ̲ty, possĭ̲ble, vanĭ̲ty.

o

ō as in bōne, mōtion, nōte, ōld, ōver.
ȱ as in anatȱmy, biolȱgy, cȱhesion, ȱbey, pȱetic.
ŏ as in hŏt, lŏck, nŏt, ŏdd, pŏd, prŏper.
ŏ̲ as in cŏ̲nform, cŏ̲nnect, ŏ̲ccur, ŏ̲ffend, pŏ̲ssess.
ô as in abhôr, bôrder, lôrd, ôrb, ôrder.
o͞o as in fo͞od, fo͞ol, mo͞on, sto͞op, to͞ol.
o͟o as in bo͟ok, co͟ok, fo͟ot, go͟od, wo͟od.
ou as in about, house, out, pout.

u

ū as in assūme, cūbe, dūty, lūte, nūde, tūbe.
u̇̄ as in emu̇̄late, gradu̇̄ate, insu̇̄lar, su̇̄preme, u̇̄nite.
ŭ as in sŭn, tŭb, ŭnder, ŭp, ŭsher.
ŭ̲ as in circŭ̲s, datŭ̲m, sŭ̲bmit, volŭ̲ntary.
ûr as in bûrn, hûrl, hûrt, ûrge, ûrn.

CONSTELLATIONS

Name	Pronunciation	Genitive	Pronunciation	Meaning
Andromeda	ăn-drŏm′ĕ-dȧ	Andromedae	ăn-drŏm′ĕ-dē	Andromeda
Antlia	ănt′lĭ-ȧ	Antliae	ănt′lĭ-ē	(air) pump*
Apus	ā′pŭs	Apodis	ăp′ŏ-dĭs	bird of paradise
Aquarius	ȧ-kwâr′ĭ-ŭs	Aquarii	ȧ-kwâr′ĭ-ī	water carrier
Aquila	ăk′wĭ-lȧ	Aquilae	ăk′wĭ-lē	eagle
Ara	ā′rȧ	Arae	ā′rē	altar
Aries	ā′rĭ-ēz	Arietis	ȧ-rī′ĕ-tĭs	ram
Auriga	ô-rī′gȧ	Aurigae	ô-rī′jē	charioteer
Boötes	bō-ō′tēz	Boötis	bō-ō′tĭs	herdsman
Caelum	sē′lŭm	Caeli	sē′lī	graving tool
Camelopardalis	kȧ-mĕl′ō-pär′dȧ-lĭs	Camelopardalis	kȧ-mĕl′ō-pär′dȧ-lĭs	giraffe
Cancer	kăn′sẽr	Cancri	kăng′krī	crab
Canes Venatici	kā′nēz vē-năt′ĭ-sī	Canum Venaticorum	kā′nŭm vē-năt′ĭ-kō′rŭm	hunting dogs
Canis Major	kā′nĭs mā′jẽr	Canis Majoris	kā′nĭs mȧ-jō′rĭs	larger dog
Canis Minor	kā′nĭs mī′nẽr	Canis Minoris	kā′nĭs mĭ-nō′rĭs	smaller dog
Capricornus	kăp′rĭ-kôr′nŭs	Capricorni	kăp′rĭ-kôr′nī	horned goat
Carina	kȧ-rī′nȧ	Carinae	kȧ-rī′nē	keel
Cassiopeia	kăs′ĭ-ō-pē′yȧ	Cassiopeiae	kăs′ĭ-ō-pē′yē	Cassiopeia
Centaurus	sĕn-tô′rŭs	Centauri	sĕn-tô′rī	centaur
Cepheus	sē′fūs	Cephei	sē′fē-ī	Cepheus
Cetus	sē′tŭs	Ceti	sē′tī	whale
Chamaeleon	kȧ-mē′lē-ŭn	Chamaeleontis	kȧ-mē′lē-ŏn′tĭs	chameleon

*Present day constellation names are in some cases abbreviations of former more complete names. The parts within the parentheses are the meanings of deleted words.

CONSTELLATIONS

Name	Pronunciation	Genitive	Pronunciation	Meaning
Circinus	sûr′sĭ-nŭs	Circini	sûr′sĭ-nī	pair of compasses
Columba	kŏ̇-lŭm′bȧ	Columbae	kŏ̇-lŭm′bē	dove
Coma Berenices	kō′mȧ bĕr′ė̇-nī′sēz	Comae Berenices	kō′mē bĕr′ė̇-nī′sēz	Berenice's hair
Corona Australis	kŏ̇-rō′nȧ ôs-trā′lĭs	Coronae Australis	kŏ̇-rō′nē ôs-trā′lĭs	southern crown
Corona Borealis	kŏ̇-rō′nȧ bō′rė̇-ā′lĭs	Coronae Borealis	kŏ̇-rō′nē bō′rė̇-ā′lĭs	northern crown
Corvus	kôr′vŭs	Corvi	kôr′vī	crow
Crater	krā′tĕr	Crateris	krā̇-tē′rĭs	cup
Crux	krŭks	Crucis	krōō′sĭs	cross
Cygnus	sĭg′nŭs	Cygni	sĭg′nī	swan
Delphinus	dĕl-fī′nŭs	Delphini	dĕl-fī′nī	dolphin
Dorado	dŏ̇-rä′dō	Doradus	dŏ̇-rä′dŭs	dorado[a fish]
Draco	drā′kō	Draconis	drā̇-kō′nĭs	dragon
Equuleus	ė̇-kwōō′lė̇-ŭs	Equulei	ė̇-kwōō′lė̇-ī	colt
Eridanus	ė̇-rĭd′ȧ-nŭs	Eridani	ė̇-rĭd′ȧ-nī	Eridanus [a river]
Fornax	fôr′năks	Fornacis	fôr-nā′sĭs	furnace
Gemini	jĕm′ĭ-nī	Geminorum	jĕm′ĭ-nō′rŭm	twins
Grus	grŭs	Gruis	grōō′ĭs	crane
Hercules	hûr′kŭ-lēz	Herculis	hûr′kŭ̇-lĭs	Hercules
Horologium	hŏr′ŏ̇-lō′jĭ-ŭm	Horologii	hŏr′ŏ̇-lō′jĭ-ī	clock
Hydra	hī′drȧ	Hydrae	hī′drē	water monster
Hydrus	hī′drŭs	Hydri	hī′drī	water snake
Indus	ĭn′dŭs	Indi	ĭn′dī	Indian
Lacerta	lȧ-sûr′tȧ	Lacertae	lȧ-sûr′tē	lizard

CONSTELLATIONS

Name	Pronunciation	Genitive	Pronunciation	Meaning
Leo	lē′ō	Leonis	lē̇-ō′nĭs	lion
Leo Minor	lē′ō mī′nẽr	Leonis Minoris	lē̇-ō′nĭs mĭ-nō′rĭs	smaller lion
Lepus	lē′pŭs	Leporis	lĕp′ŏ-rĭs	hare
Libra	lī′brȧ	Librae	lī′brē	balance
Lupus	lū′pŭs	Lupi	lū′pī	wolf
Lynx	lĭngks	Lyncis	lĭn′sĭs	lynx
Lyra	lī′rȧ	Lyrae	lī′rē	lyre
Mensa	mĕn′sȧ	Mensae	mĕn′sē	table (mountain)
Microscopium	mī′krō̇-skō′pĭ-ŭm	Microscopii	mī′krō̇-skō′pĭ-ī	microscope
Monoceros	mō̇-nŏs′ẽr-ŏs	Monocerotis	mō̇-nŏs′ẽr-ō′tĭs	unicorn
Musca	mŭs′kȧ	Muscae	mŭs′sē	fly
Norma	nôr′mȧ	Normae	nôr′mē	square (and rule)
Octans	ŏk′tănz	Octantis	ŏk-tăn′tĭs	octant
Ophiuchus	ŏf′ĭ-ū′kŭs	Ophiuchi	ŏf′ĭ-ū′kī	serpent holder
Orion	ō̇-rī′ŏn	Orionis	ō′rĭ-ō′nĭs	Orion
Pavo	pā′vō	Pavonis	pā̇-vō′nĭs	peacock
Pegasus	pĕg′ȧ-sŭs	Pegasi	pĕg′ȧ-sī	Pegasus [winged horse]
Perseus	pûr′sūs	Persei	pûr′sē̇-ī	Perseus
Phoenix	fē′nĭks	Phoenicis	fē̇-nī′sĭs	phoenix
Pictor	pĭk′tẽr	Pictoris	pĭk-tō′rĭs	painter's (easel)

CONSTELLATIONS

Name	Pronunciation	Genitive	Pronunciation	Meaning
Pisces	pĭs′ēz	Piscium	pĭsh′ĭ-ŭm	fishes
Piscis Austrinus	pĭs′ĭs ôs-trī′nŭs	Piscis Austrini	pĭs′ĭs ôs-trī′nī	southern fish
Puppis	pŭp′ĭs	Puppis	pŭp′ĭs	stern
Pyxis	pĭk′sĭs	Pyxidis	pĭk′sĭ-dĭs	mariner's compass
Reticulum	rĕ-tĭk′ŭ-lŭm	Reticuli	rĕ-tĭk′ŭ-lī	net
Sagitta	sȧ-jĭt′ȧ	Sagittae	sȧ-jĭt′ē	arrow
Sagittarius	săj′ĭ-tā′rĭ-ŭs	Sagittarii	săj′ĭ-tā′rĭ-ī	archer
Scorpius	skôr′pĭ-ŭs	Scorpii	skôr′pĭ-ī	scorpion
Sculptor	skŭlp′tĕr	Sculptoris	skŭlp-tō′rĭs	sculptor's (workshop)
Scutum	skū′tŭm	Scuti	skū′tī	shield
Serpens	sûr′pĕnz	Serpentis	sĕr-pĕn′tĭs	serpent
Sextans	sĕks′tănz	Sextantis	sĕks-tăn′tĭs	sextant
Taurus	tô′rŭs	Tauri	tô′rī	bull
Telescopium	tĕl′ĕ-skō′pĭ-ŭm	Telescopii	tĕl′ĕ-skō′pĭ-ī	telescope
Triangulum	trī-ăng′gŭ-lŭm	Trianguli	trī-ăng′gŭ-lī	triangle
Triangulum Australe	trī-ăng′gŭ-lŭm ôs-trā′lē	Trianguli Australis	trī-ăng′gŭ-lī ôs-trā′lĭs	southern triangle
Tucana	tŭ-kā′nȧ	Tucanae	tŭ-kā′nē	toucan
Ursa Major	ûr′sȧ mā′jĕr	Ursae Majoris	ûr′sē mȧ-jō′rĭs	larger bear
Ursa Minor	ûr′sȧ mī′nĕr	Ursae Minoris	ûr′sē mĭ-nō′rĭs	smaller bear
Vela	vē′lȧ	Velorum	vē-lō′rŭm	sails
Virgo	vûr′gō	Virginis	vûr′jĭ-nĭs	virgin
Volans	vō′lănz	Volantis	vō-lăn′tĭs	flying (fish)
Vulpecula	vŭl-pĕk′ŭ-lȧ	Vulpeculae	vŭl-pĕk′ŭ-lē	little fox

FIFTY IMPORTANT SPECIAL STAR NAMES

Name	Pronunciation	Equivalent
Achernar	ā′kẽr-när	α Eridani
Albireo	ăl-bĭr′ē-ō	β Cygni
Alcor	ăl′kôr	80 Ursae Majoris
Alcyone	ăl-sī′o̊-nē	η Tauri
Aldebaran	ăl-dĕb′ȧ-răn	α Tauri
Algenib	ăl-jē′nĭb	γ Pegasi
Algol	ăl′gŏl	β Persei
Alioth	ăl′ĭ-ŏth	ε Ursae Majoris
Alkaid	ăl-kād′	η Ursae Majoris
Almach	ăl′măk	γ Andromedae
Alphard	ăl′färd	α Hydrae
Alphecca	ăl-fĕk′ȧ	α Coronae Borealis
Alpheratz	ăl-fē′răts	α Andromedae
Altair	ăl-tār′	α Aquilae
Antares	ăn-tā′rēz	α Scorpii
Arcturus	ärk-tū′rŭs	α Boötis
Bellatrix	bĕ-lā′trĭks	γ Orionis
Betelgeuse	bĕt′ẽl-jŭz	α Orionis
Canopus	kȧ-nō′pŭs	α Carinae
Capella	kȧ-pĕl′ȧ	α Aurigae
Castor	kȧs′tẽr	α Geminorum
Deneb	dĕn′ĕb	α Cygni
Deneb Kaitos	dĕn′ĕb kā′tŏs	β Ceti
Denebola	dĕ-nĕb′o̊-lȧ	β Leonis
Dubhe	dŭb′ē	α Ursae Majoris

FIFTY IMPORTANT SPECIAL STAR NAMES

Name	Pronunciation	Equivalent
Elnath	ĕl′năth	β Tauri
Fomalhaut	fō′măl-ôt	α Piscis Austrini
Hamal	hăm′ăl	α Arietis
Merkab	mĕr′kăb	α Pegasi
Megrez	mē′grĕz	δ Ursae Majoris
Menkar	mĕn′kär	α Ceti
Merak	mē′răk	β Ursae Majoris
Mira	mī′rȧ	ο Ceti
Mirach	mī′răk	β Andromedae
Mirfak	mĭr′făk	α Persei
Mizar	mī′zär	ζ Ursae Majoris
Phecda	fĕk′dȧ	γ Ursae Majoris
Polaris	pō-lā′rĭs	α Ursae Minoris
Pollux	pŏl′ŭks	β Geminorum
Procyon	prō′sĭ-ŏn	α Canis Minoris
Rasalgethi	rȧs′ăl-jē′thē	α Herculis
Rasalhague	rȧs′ăl-hā′gwē	α Ophiuchi
Regulus	rĕg′ū-lŭs	α Leonis
Rigel	rī′jĕl	β Orionis
Scheat	shē′ăt	β Pegasi
Schedar	shĕd′ȧr	α Cassiopeiae
Sirius	sĭr′ĭ-ŭs	α Canis Majoris
Spica	spī′kȧ	α Virginis
Thuban	thōō′băn	α Draconis
Vega	vē′gȧ	α Lyrae

CLUSTERS

Name	Pronunciation	Description
Hyades	hī′ȧ-dēz	Open star cluster in Taurus
Pleiades	plē′yȧ-dēz	Open star cluster in Taurus
Praesepe	prē-sē′pē	Open star cluster in Cancer

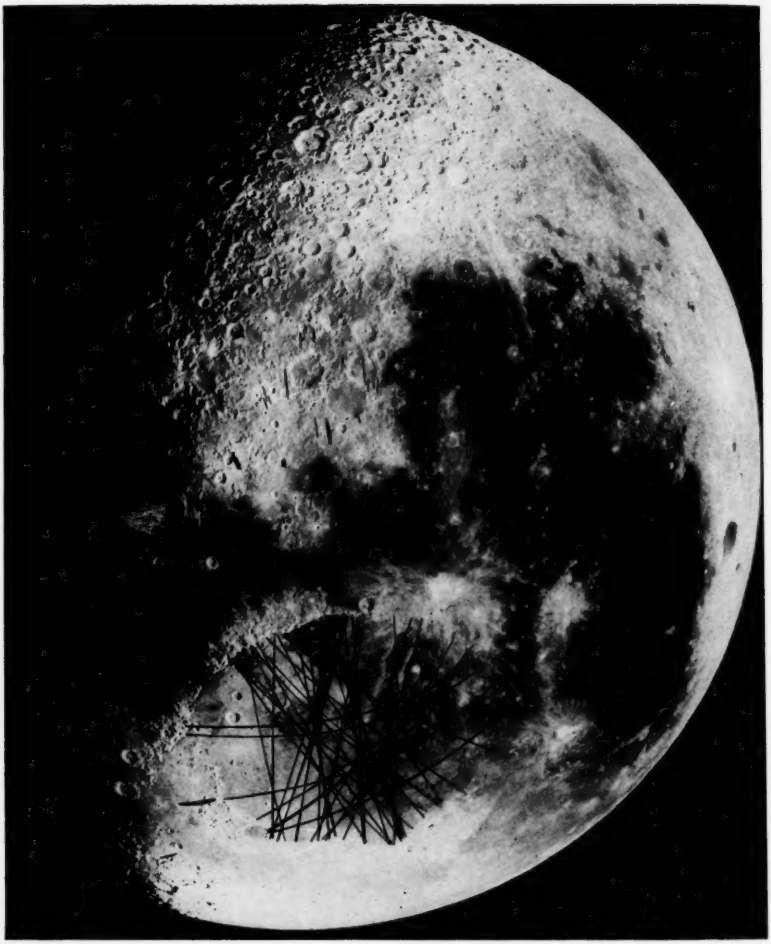
PLANETS

Name	Pronunciation	Name	Pronunciation
Mercury	mûr′kū-rĭ	Saturn	săt′ĕrn
Venus	vē′nŭs	Uranus	ū′rȧ-nŭs
Earth	ûrth	Neptune	nĕp′tūn
Mars	märz	Pluto	plo͞o′tō
Jupiter	jo͞o′pĭ-tĕr		

GREEK ALPHABET

	Name	Pronunciation		Name	Pronunciation
α	Alpha	ăl′fȧ	ν	Nu	nū
β	Beta	bā′tȧ	ξ	Xi	zī
γ	Gamma	găm′ȧ	ο	Omicron	ŏm′ĭ-krŏn
δ	Delta	dĕl′tȧ	π	Pi	pī
ε	Epsilon	ĕp′sĭ-lŏn	ρ	Rho	rō
ζ	Zeta	zā′tȧ	σ	Sigma	sĭg′mȧ
η	Eta	ā′tȧ	τ	Tau	tou
θ	Theta	thā′tȧ	υ	Upsilon	ūp′sĭ-lŏn
ι	Iota	ī-ō′tȧ	φ	Phi	fī
κ	Kappa	kăp′ȧ	χ	Chi	kī
λ	Lambda	lăm′dȧ	ψ	Psi	sī
μ	Mu	mū	ω	Omega	ō-mē′gȧ

PLATE III



Photograph made at the Yerkes Observatory.

MARE IMBRIUM AND RADIAL SPLASH MARKINGS

The Meteoritic Origin of Lunar Craters

By RALPH B. BALDWIN

Every new scientific instrument solves certain mysteries. It also uncovers numerous others; some of these are soon cleared up, others remain mysteries. Scientific interest sometimes is diverted to other fields and the unsolved problems receive less and less attention.

One such matter is that pertaining to the origin of the lunar craters. During the centuries since the invention of the telescope, astronomers have been divided into two opposing groups, one favoring the meteoritic impact theory and the other group being equally definite in stating that the lunar craters were volcanic in nature. Occasional brave men advocated other and less popular theories.

The author has made a survey of the visible surface of the moon in an attempt to find features which are explicable only in terms of one manner of origin or the other. A result was the correlation of numerous lunar markings which must have had a common cause and which are adequately explained as phenomena resultant to a gigantic explosion.

Before describing these features it seems best to advance arguments against other theories of crater origin.

On the earth, the volcanic pits are usually at the crest of the mountain, or in some cases, such as Kiluaea, high on the side. The terrestrial volcanic mountain is formed, in general, not by explosive vulcanism, but by a secular increase due to successive lava flows, some emanating from the crater, some coming from fissures at various heights along the slope of the mountain. The lunar craters almost universally show many evidences of explosive action and hence are of a nature different from that of terrestrial volcanoes.

A suggestion was made by Tomkins and still later by Marshall[1] that the craters were caused by laccolithic formations. This theory does not explain the existence of a central mountain peak, unless later vulcanism built up the peak within the crater formed by the laccolith, nor the great quantities of material ejected radially from so many craters. Each is an effect to be expected if the craters are of meteoritic origin. Aristillus beautifully exemplifies both effects, located as it is on the relatively smooth surface of Mare Imbrium.

Arguments of this nature have been used before, but, although necessary, have never been accepted as sufficient to completely establish the meteoritic theory. Hence the survey, mentioned above, was made. Structures explicable only as markings produced because of meteoritic impact were found.

Southeast of Mare Serenitatis in Mare Vaporum and extending south-

[1] *Publ. A.A.S.* **10**, No. 4, 167, 1942.

westward from the Apennines to Mare Tranquillitatis is a series of at least a dozen craters which are elongated in the southwest-northeast direction. Their average length is about sixty miles and they are four or five times as long as broad. This is in great contrast to the almost perfectly circular outlines of most craters. Their major axes are all nearly, but not quite, parallel. Craters of this type are found no where else on the moon.

Thus their nature, location, and orientation mark them as a unique type and are overpowering evidence of a common origin. Formations like these certainly are not volcanic in nature. They could only have been formed by the almost tangential impacts of tremendous masses of material. These bodies could not have approached the lunar surface at high angles or circular craters would have been formed. The direction from which the shot-gun-like blast came may be determined by noting that the projected crater axes are convergent toward the northeast. If the axis of each crater is continued as the arc of a great circle in this general direction, all pass close to the center of Mare Imbrium.

After noting this interesting fact, the search was continued for other similar features which might have had a common origin. A series of long sharp grooves running nearly north-south was found in the region of Hipparchus, Ptolemaeus, Alphonsus, and Albategnius. They are from ten to seventy miles long and perhaps two or three miles broad. These grooves cut indiscriminately through crater walls, bottoms, and regions between the craters and in appearance resemble the elongated craters in Mare Vaporum, although they are much narrower. They are not to be confused with the random and irregular rills. Probably they were produced by bodies travelling more rapidly than those which made the former markings.

A common origin for these grooves is indicated by their near parallelism. Their axes projected in the convergent direction, northward, all pass through the central section of Mare Imbrium and thus intersect in that region the projected axes of the elongated Mare Vaporum craters.

A third type of feature appears in the territory northeast of Ptolemaeus and extending beyond Copernicus. These structures are ridges; most of them are about twenty miles long and perhaps three miles broad. In practically every case, their projected longer axes pass through the same central region of Mare Imbrium as do those lines which have been discussed previously.

Two other similar features may be mentioned. Extending diametrically across Alphonsus is a ridge which is oriented in the same manner as the nearby gashes. Also the long Alpine Valley points toward the central section of Mare Imbrium.

The most prominent markings of these three kinds have been indicated

in Plate III.[2] The projected axes are also shown intersecting in the great sea. However, close inspection of the entire central region of the moon shows that there are innumerable similar, but less outstanding, markings all radiating from the middle of Mare Imbrium.

The existence of so many features which are oriented toward this lunar sea is evidence that some terrific explosion occurred at that point of the moon's surface and that the markings were caused by material ejected radially from the point of explosion. It may be noted that the ridges average closer to Mare Imbrium than do the elongated craters, and that the grooves are the most distant of all.

The violence of this explosion must have been such that we may associate it with the actual formation of Mare Imbrium. In this view, Mare Imbrium is nothing more nor less than the largest crater on the moon. This sea is essentially circular, being about seven hundred fifty miles in one direction and six hundred fifty in the other. The entire escarpment is mountainous, particularly in the southwest, or Apennine region, except that the eastern border where Mare Imbrium joins Oceanus Procellarum has been destroyed. The rim is similar to the usual crater wall in that it is steeper on the inner than outer side. The Apennine section of the wall is the highest and it is just in this direction that the most prominent of the radial markings are found.

In the opinion of the author, the tremendous size of Mare Imbrium precludes its being volcanic in origin.

With these facts in mind, we may re-construct a portion of the moon's probable history.

We shall assume, in accordance with a widely accepted hypothesis, that the moon was once part of the earth. When it broke away there was undoubtedly a good deal of material from the fission region which did not immediately coalesce with either major body. The moon very quickly formed a solid crust. Its gravitation, acting like a gigantic vacuum sweeper, gradually caused numerous small bodies to plunge to the lunar surface. These impacts were the sources of the craters.

After most of the craters had been formed, a much larger body, probably of asteroidal dimensions, crashed to the surface in the northeast quadrant, coming from the northeast. The resultant explosion produced the mountainous rim of Mare Imbrium and the numerous "splash craters" and ridges radial to the sea. The original mountain ranges bordering the sea show evidences that they once were much higher and that the inner slopes had caved in toward the center. Similar effects are noticed at most large craters, *i.e.,* the inner walls are terraced.

An effect of the blast may be seen on the southern and southeastern walls of Mare Serenitatis. They have been extensively mutilated by

[2] It is suggested that the reader examine the indicated regions on large scale photographs of the moon. Yerkes slides M_3, M_6, M_{16}, M_{17}, M_{23}, and Mount Wilson slides H_7, H_8, H_9 are recommended.

flying material emanating from Mare Imbrium. The general appearance is that of a long curving ridge of sand upon which a spray of water has been turned. Consequently it may be assumed that Mare Serenitatis antedates Mare Imbrium and, from its character, is probably another tremendous crater similar to the latter.

If Mare Serenitatis was formed first, why is its surface free of markings radial to its larger neighbor? The answer to this question is to be found in the logical succession of events after the impact producing Mare Imbrium. The colliding body probably was of the order of seventy-five miles in diameter. Upon impact a tremendous amount of rock would have been liquified. In addition, the surface layers of the moon would have been smashed so thoroughly as to expose lower layers, which, presumably, were still molten. Hydrostatic pressure alone, from the weight of the newly arrived matter as well as that from the neighboring lava level forced molten rock to the surface where it practically filled up Mare Imbrium and then burst its bonds. To the west it plunged through the gap between the Apennine and Caucasus Mountains into Mare Serenitatis, overflowed its entire area and spread beyond into Mare Tranquillitatis and its branches. A crust formed over the lava in Mare Serenitatis and Mare Tranquillitatis even before the lava flow stopped. This led to the formation of pressure ridges in both seas. Two of them are particularly prominent at the closed western end of Mare Serenitatis.[3]

At the eastern end of Mare Imbrium the rim of mountains was actually destroyed, probably melted away, and it was in this direction that the largest lava flow occurred. The liquid sheet spread out over the regions now called Oceanus Procellarum and Mare Nubium. In the latter sea large numbers of partially drowned craters are still visible as evidence that they were produced earlier in the moon's history than the vast seas.

Certain craters, such as Copernicus, Archimedes, Autolycus, and Aristillus, as well as numerous others, obviously came later than the great lava flows as they are superimposed on them. In Plato and Archimedes, for examples, lava evidently has welled up after their formation and partially filled the interiors. Wargentin was filled with lava completely.

There probably have been similar histories for most craters and hence their present depths are not an indication of the depth to which the original impact explosion penetrated.

The pattern of crater genesis, then, would seem to be as follows. A collision between the lunar surface and a meteoritic mass caused a terrific explosion as the kinetic energy of the meteor was converted into

[3] The suggestion that these features in the lunar seas are pressure ridges in the lava was made to the author by Dr. Dean B. McLaughlin. They may be compared to similar ridges in arctic sea ice.

heat. This explosion produced the crater proper and scattered a considerable amount of matter radially over the landscape. A central mountain peak might have been formed in the original process, or it might have been due to subsequent vulcanism. As a direct result, lava from sub-surface strata, and possibly some produced by the energies released at contact, partially filled the crater pit. In the case of the largest of all craters, Mare Imbrium, the lava burst out of the restraining walls and spread over a very large area of the moon's surface.

Three of the large crater-seas have been identified. They are, in order of increasing size, Mare Crisium, Mare Serenitatis, and Mare Imbrium. Possibly Sinus Iridum is another, the smallest of the type. The balance of the craters range from one hundred fifty miles in diameter downward.

Vulcanism is thus a follow-up mechanism in the formation of the major lunar features. Volcanic action alone probably caused some of the smaller craters, such as those about one hundred miles northwest of Copernicus. They are strung along a fault, and are either examples of primary volcanic processes or are simply vents along a crack in the crust over the main lava flow from Mare Imbrium. Perhaps some of the central mountain peaks in craters are to be considered as volcanic.

The very great majority of lunar craters, however, were not formed by this method, but were produced by a violent explosion attendant upon meteoritic action.

DEARBORN OBSERVATORY, EVANSTON, ILLINOIS, APRIL 4, 1942.

Demonstration Equipment for Effective Teaching in Astronomy*

By ROBERT L. PRICE

In reviewing aids to effective teaching in science, the advice received from my teachers and colleagues is recalled. Professor Todd's "New Astronomy" was recommended for its fine diagrams and models. Periodicals devoted to teaching methods and stressing the understanding of subject matter were suggested. The use of simple, straight-forward methods and demonstrations, oftentimes with the most inexpensive devices available, was urged.

The Joliet junior college course on which this discussion is based is an elective one open to all students and might be described as an appreciation course of a descriptive nature. An attempt is made to have the student "carry over" his interest and keep up on the subject with subsequent reading and observation. As a consequence, astronomy texts

*Read at Dallas, Texas, on December 31, 1941, at a Symposium on Problems of Teaching Astronomy.

are usually not for sale after the completion of the course but are retained for personal use.

Originally planned as a four semester-hour course with a weekly laboratory period, the course was modified to parallel that of the University of Illinois and reduced to a three semester-hour one. Since laboratory equipment had been supplied in the meantime, some work was included, the exercises being adapted to a shorter period and modified so that graphs and charts could be completed outside the laboratory. When complete elimination of this type of work has been suggested, the students have made a definite stand against the move with the statement, "That's where we get things straightened out!"

The use of much lecture demonstration material follows from our connection with a well-equipped elementary physics laboratory. The physics teacher stimulates interest with models and demonstration equipment much of which can be set in motion or holds the attention in some other way. This follows the suggestion of a great English scientist that to arouse interest "have something going."

Many of the four hundred lantern slides used in the course are the conventional astronomical photographs illustrating objects which one can not see well, or at all, in a small telescope. Perhaps one-fourth of them are definitely teaching aids in the form of diagrams, or photographs of apparatus, to be used in conjunction with models or demonstrations to clarify such matters as systems of coordinates, parallax, and the principles of spectroscopy.

Constellation study has usually been carried on at the same time as telescopic observations were being made. The Welch Pocket Planetarium and the Chicago Stellarscope have been used as illuminated star charts but the outlining of constellations with the aid of a strong focusing flash-light pointer has been the most effective method used in our almost perpetually hazy sky. With the outline in mind, the student can work his own way from there on.

Observation with the 4½-inch Clark refractor is limited to the use of the lower power, more or less, because of the city lights and because the aim has been to have the student see the objects which he may find with his own instrument or with one in his neighborhood. Several reflectors are available, the largest being a 16-inch instrument of high quality.

The students are urged to visit the Adler Planetarium at least once and on that trip they are advised to see the meteorite collection and model of the moon at the Field Museum. The exhibits at the Planetarium of special interest are: the miniature planetaria, the instruments on a ship's bridge, the large telescopes and mountings, and the array of historical material displayed.

The high standard of the lectures and activities of the Joliet Astron-

omical Society provides an opportunity for further growth to the student.

This descriptive course, then, utilizes the lecture-demonstration method with use of many lantern slides, a weekly laboratory exercise of an elementary character, and optional evening observational work, planetarium trips, and attendance at meetings of the local astronomical group.

Mechanical Devices Large Enough to be Seen by a Group

The coelosphere has proved most useful for illustrating the systems of coordinates and, in the absence of a planetarium, it shows to advantage the relation of the ecliptic to the equator and the relation of these two to the horizon at different times throughout the year. This aids in explaining the harvest and the hunter's moons, the elongations when the planet Mercury can best be seen, the "wet" and "dry" moons, diurnal circles throughout the year for sun and moon, emphasizing the summer and winter elevations above the horizon. Skilling and Richardson in their textbook on Astronomy illustrate a similar device with the sun and earth represented at the center where the coelosphere shows the earth alone. They also illustrate a small model made with a glass flask on which the circles are marked. A similar apparatus to those mentioned here is the Solar Calculator listed by the L. E. Knott Co.

The seasons apparatus, due to the Geo. S. Gardner Co. and dated 1899, is valuable in illustrating the earth's motion around the sun with the earth's axis maintaining its fixed direction. The sun's rays are shown as they strike the earth, accounting for the climatic zones, hours of daylight, and allied phenomena.

The Foucault pendulum apparatus is made available for use in rooms of ordinary height. The effect of the earth's rotation is made visible in a few minutes by projecting the shadow of the supporting wire at maximum displacement.

The planetary configurations apparatus consists of a large vertical disk with two spheres on arms which may be turned about a central "sun." A direction pointer is fastened in a swivel on one sphere and is free to move through a swivel on the other. It thus shows the motion of the latter "planet" as seen from the former as the pointer swings through the background of stars on the border of the disk, illustrating direct and retrograde motions. Configurations of both inferior and superior planets can be shown as well as their phases.

A gyroscope which can be mounted and balanced on a pointed support, can be made to precess by shifting a movable weight and introducing a torque. An earth-model type of gyroscope shows the equatorial bulge, the intersection of the planes of the equator and ecliptic, and the ecliptic pole. The cone swept out by the earth's axis becomes apparent and "nodding" can be introduced.

The constancy of angular momentum demonstration depends upon varying the moment of inertia, as in the old physics demonstration where a person varies the position of masses which he holds as he is rotated on a stool or platform. Angular velocity increases as the masses are moved towards the axis.

The center of gravity of the earth-moon system is shown by Professor Sutton with a model. The system is rotated by producing a twist in a suspension midway between the two bodies but they revolve about another point, their common center of gravity, which is marked by an illuminated flash-light bulb which is seen to remain stationary.

A large scale conic section model in the form of a dissectible cone is available. Most teachers have doubtless used a cone cut in the several ways to show the curves which represent the possible types of orbits.

Projection of spectra has been helpful in introducing this subject and the Eaton Direct Vision Prism which uses a liquid of high index of refraction has made possible the projection of a wide and high continuous spectrum from a rather intense source. Light from a large and relatively wide slit is focused on the prism. If sodium chloride is introduced in the arc as a source, the prominent bright line will flash into view. Carbons impregnated with various salts are suggested for the bright line spectra. The absorption by sodium vapor, formed by heating sodium in an iron spoon beneath the slit, becomes visible for a brief period as a rather broad dark line at the position of the sodium line.

The Doppler effect is perhaps best illustrated by the case in sound and some form of rotating sound source, such as the vibrating reed, is simplest to show. The student must be warned to listen for a variation in pitch rather than in intensity.

The cause of absorption lines may be approached from the study of resonance with the resonance pendulums and resonance bars.

Mechanical slides should be developed to greater use and perfection. B. H. Wilson of this faculty has adapted the principle found in an old slide showing an annular eclipse, a partial eclipse, and a transit of a planet, to show the progress of a total eclipse of the sun, which he "tops off" with a fine view of the corona. This delights the students who hardly hope ever to see a total eclipse.

Another old slide found here shows the configurations of an interior planet in motion about a dazzling sun!

D. L. Barr has devised a rotating slide to make the diurnal motion and seasonal changes of the circumpolar groups more real.

Charts

Wall charts are of great value if made available to the student over a period of time. A lantern slide of the same chart will not give the opportunity for study that the wall chart does. At Wilson Junior College in Chicago, W.P.A. help has been used to make large size charts

of many diagrams, graphical studies and other teaching material in physics. Similar charts could be made dealing with astronomical subjects, which would save time for the lecturer and, at the same time, give the student an accurate, legible diagram or table.

Among the smaller charts which can be used individually in the class or laboratory to good advantage is the Twilight Chart, "an orthographic projection of the celestial sphere," which can be rectified for any latitude. Hours of daylight and twilight can be quickly found for the place in question, at the equinoxes and at the solstices. Another form of solar chart, by Professor Joseph E. Morse of Hyde Park High School, Chicago, goes by the name, "Sun Dial," and gives some additional information on insolation.

Several small charts by Sylvan Harris are available through the Welch Company. They deal with such topics as: Time Around the Globe, Phases of the Moon, Telling Time by the Stars, Zodiacal Constellations, etc.

We have been fortunate to have some copies of charts made by John Foeh, late member of the local group, showing the apparent paths of the planets, similar to those illustrated in the *Observer's Handbook* and in POPULAR ASTRONOMY.

Wall charts showing members of the solar system, the revolution of the earth around the sun, the seasons, phases of the moon, the Elger moon map, kinds of eclipses, types of spectroscopes, types of telescopes, are available through several sources.

"The Dimensions of Natural Objects in Miles," a Century of Progress mural, takes the student from the infinitesimal to the infinite, graphically speaking.

The Compton Chart of Electromagnetic Radiations includes much of astronomical interest, particularly, relative to the spectrum and the sun's energy. It gives a general review of light phenomena and some material on cosmic rays.

The Denoyer-Geppert Astronomical Geography Chart deals with the sky, moon, earth, and sun. Removable sections allow for illumination through transparent sections to show phases of the moon, the cause of seasons, day and night on the earth, and a moon map. The chart of the sky is adjustable.

A comprehensive spectrum chart manufactured by the W. M. Welch Scientific Company illustrates grating spectra for the following: a continuous spectrum, many bright-line spectra, the solar spectrum, the Doppler effect for an approaching star and for a receding star, and absorption by several solutions. Emission spectra from molecular sources are not included.

Imported Charts of Prismatic Spectra showing the stellar types as well as those of nebulae, sunspots, planets, and the aurora, were former-

ly obtainable through the Eastern Science Supply Company.

A Rowland Solar Spectrum Chart made with the concave grating is a valued teaching aid. It can be spread out for some forty feet and used in conjunction with the Mount Wilson slide in the study of the structure of the lines under greater separation.

A Metric Chart is not out of place in the astronomy laboratory and will aid the student in "brushing up" on metric units.

Globes and Planetaria

The moderately-sized globes for laboratory purposes meet most needs in studying coordinates, diurnal circles at the pole, at the equator, and in middle latitudes, circles of perpetual vision and occultation, positions of the planets, sun, and moon. The student must overcome the difficulty of looking from the outside in and learn the use of the globe with a pointer if he is to locate objects in the sky when he has set the globe properly. The Rand-McNally celestial globe has a scale at the north pole to facilitate setting for any date and hour and a handbook is supplied with it. The lack of an horizon scale limits its laboratory use although the sphere seems to be made accurately enough and a degree scale can be made on any flexible material and be used with it.

The Hall Tellurian is an earth globe with a meridian band, a time band, and a sunrise-sunset circle. With it, many ideas of time and seasons can be shown with a few adjustments of the sphere.

The Hackeling Tellurian is similar to the seasons apparatus and represents sun, earth, and moon globes in a planetarium arrangement. *The Trippensee Planetarium* has an additional feature in the representation of an inferior planet in its orbit. *The Essco Planetarium* has both inferior planets and Mars moving at the proper rates while the earth-moon system is in motion. *The Calendarium and Planetomobile* are similar devices manufactured by the Educational Supply Company of Houston, Texas.

Models

Sir Wm. Bragg has said in referring to crystals, "If one can turn over a model in one's hand, an idea can be seized in a mere fraction of the time that is required to read about it, and a still smaller fraction of the time that is required to prepare the description."

Skilling and Richardson describe an eclipse model showing the moon's orbit inclined to that of the earth at various times of the month.

The Milwaukee Astronomical Society recently exhibited a model to show how meteors appear to be in different parts of the sky as seen from different points on the earth's surface. This should be of value in the exercise on determination of meteor heights.

"The Pin Point Planetarium" of Armand Spitz or the Beckley-Cardy illuminated pin-hole outlines of the constellations which are on a larger scale, may have some value in arousing interest as well as in teaching.

Among the models of instruments are those of the astronomical telescope, the Galilean telescope, and the terrestrial telescope. These may be obtained as units or assembled with lenses in holders on a meter stick. An alt-azimuth instrument, a sextant, vertical and horizontal sun-dials, a six-inch reflector, and a spectroscope are instruments which can readily be shown in the classroom or laboratory. Models of these can be obtained in some cases.

The large-scale, three-dimensional models are cumbersome for use anywhere except in the museum, but the idea is good. A Leonid meteor model can be made with a transparent material on which the earth's orbit is traced and the orbit of the Leonids can be shown to intersect the earth's orbit with the use of a wire loop.

Demonstrations and Phenomena to be Viewed Individually

Stereoscopic views such as those in "Starcraft" give the three-dimensional effect without the use of cumbersome models, although they give only one view-point. If publishers would supply sets of these sufficient for a class, the viewing equipment could be made rather inexpensively. Viewing pictures in a book is not highly satisfactory because of the binding.

A conic section demonstrator which can be operated by the observer is described in the December issue of *School Science and Mathematics*. A conical beam of light strikes a plane screen which when rotated has the curves outlined on it.

Laboratory activities which require individual observing are: measuring the sun's or moon's diameter with a split objective, viewing stellar spectra, using the knife-edge test, observing projected sunspots, observing light phenomena such as the fringes in the Michelson interferometer.

In our laboratory study of spectra, several Gaertner spectroscopes, some direct-vision spectroscopes and some gratings are used. Vacuum tubes are used for sources of hydrogen, helium, and mercury bright-line spectra. Flame spectra of sodium, strontium, lithium, and potassium are examined, as well as the cadmium spark. The blue cone of the Bunsen burner and the luminescence of the nitrogen tube are the sources of molecular spectra. Absorption spectra are produced by sodium vapor, permanganate solution, chlorophyll solution, and glass filters. The exercise is based on that of Professor Duncan but our chart of spectrum lines emphasizes Angstrom units. The supplementary charts and slides are used here since the topic is basic and the ideas often new to most of the students.

Specimens of meteorites, some etched, may be passed around or put on display. Our specimens are loaned by the geology department.

Transparencies

When large-sized transparencies are available, they are illuminated by daylight at the windows. Fluorescent lighting is highly satisfactory as shown by Mrs. Lois Buttles in educational units which she and her husband, the late W. S. Buttles, developed, using paper transparencies.

For some years, we have used a wooden frame for exhibiting lantern slides as transparencies. A tracing cloth over the back of the frame diffiuses light from a photographic reflector sufficiently to give a fairly uniform illumination. The frame accommodates about twenty-five slides which cover any given unit such as that on the moon.

A commercial development called to our attention by Professor C. C. Wylie is the Multiplex Lantern Slide Cabinet which is useful for storage and easy selection of slides by viewing the slides with daylight illumination. This device could easily be made available to students who might wish to review the slides after the brief showing during a lecture.

At present we plan to obtain an enlarged positive of a gorgeous corona photograph by Frank M. Preucil during the auroral display of September 18, 1941. With the proper color for illumination, a fine effect should be obtained.

Teaching Films and Special Materials

From time to time, we make use of the Erpi sound films on astronomy, although they must be shown in our large auditorium. A topic such as the Law of Areas is handled in a way difficult to put into words. The "change of pace" of the planet in its motion about the sun is brought out in an excellent manner.

The early McMath-Hulburt films were of great value and we await with interest the new series which we hope will be generally available.

Some film-slides on astronomical subjects such as observatories and eclipses have been used but they have not been sufficiently accurate or "meaty."

A number of special slides dealing with topics discussed by the local society have been made available. These include views of aurorae, Nova Herculis, movements of Mars and Jupiter over several weeks, the moon at various phases, variable star charts and graphs, some constellations, and the complete series of the Benld meteorite (Illinois No. 2), all photographed by Mr. Preucil who was one of the investigators of this fall.

Professor Clarence R. Smith of Aurora (Illinois) College has a series of photographs showing the changing sunset point.

A bulletin board of generous proportions is covered with "scrap book" material and clippings which accumulate at a terrific rate.

"Milestones in Optical History," a Bausch and Lomb publication has a splendid series of colored copies of paintings which can also be procured for framing, or framed. Many departments now have the large-

sized reproduction of Galileo demonstrating his telescope but this is no longer available.

Mimeographed Information

Besides the usual tables, charts, and laboratory notes, it has been suggested that when demonstrations are given, before a large group particularly, a mimeographed outline be supplied to the student to relieve him of taking notes. He can then give full attention and make additions while reviewing the material later on. The method is used at Purdue University in the physics lectures and has been urged by Professor John A. Eldridge of the University of Iowa.

Mimeographed descriptions and directions for operating devices placed on display in the demonstration laboratory facilitate their operation.

Joliet Junior College, Joliet, Illinois.

Marvelous Voyages—IV

Jules Verne, Around the Moon

By LAURENCE J. LAFLEUR

In the April issue we dealt with the plans for a voyage to the moon in a projectile. We now consider Verne's "Around the Moon," wherein we follow the fortunes of the three travellers, Ardan, Barbicane, and Nicholl.

The projectile was intact after the explosion. A few objects were hurled to the roof, but most remained uninjured. The three men were unconscious, but soon revived, and, of the animals carried, only one dog, Satellite, died. As soon as they revived, the three men address themselves to the problem of determining whether the projectile is still moving moonwards, or whether it is falling, or perchance resting in the cannon or on the bottom of the Gulf of Mexico. Barbicane concludes that the high temperature of the interior (48° C., or 118° F.) is caused by friction with the atmosphere and that the projectile must therefore be moving; which would seem reasonable to his companions except that they had heard no sound of the explosion. After the question is settled by looking out of the portholes, they decide that no sound was heard because they were travelling faster than sound. At the first lateral porthole they were unable to see the moon, which, moving from east to west, will not reach the zenith until four days later. But before they move to the other lateral porthole they observe a close encounter with a second satellite of the earth. This is luminous as they approach it, but disappears completely when they pass, since from the opposite direction it is in the "new" phase. This satellite circles the globe in three hours and twenty minutes, and is only 5,000 miles from its surface. The

second lateral porthole enables them to see the moon, and the one in the base, whose glass is thick enough to support the weight of the trio, shows them a thin crescent earth.

A little more than ten hours have passed when the projectile emerges from the earth's shadow, and the sun commences to warm it. At this point the three men examine their instruments, which are practically all in working order. The compasses show no steady magnetic field. Discussing the possible inhabitants of the moon, Barbicane argues that if inhabited, the development of its life would have preceded that on earth by several thousands of years, and its inhabitants, if similar to those of earth, will be far more civilized than men. Meanwhile the dog, Satellite, has died, and they decide to open one of the portholes to throw out the body, but they realize that they must act with great speed for two reasons: first, not to let much air escape; second, not to let the cold of outer space enter the chamber. The operation succeeds perfectly, causing the loss of only a few molecules, and they use this method henceforth to rid themselves of waste materials. The corpse of Satellite, it may be remarked, becomes truly a satellite of the projectile, accompanying them on the rest of their journey.

Many astronomical questions are discussed by the voyagers—the absolute minimum of temperature, which they expect to be 60° or 160° C. below zero, the nature of the ether, of whose atoms Barbicane gives a detailed description, the effect of a sudden stoppage of the projectile, which would raise its temperature to the point of vaporizing, and the appearance of an eclipse viewed from the moon, which Barbicane says will always be annular, due to the refraction of the sun's rays by the earth's atmosphere.

They question whether their original velocity will carry them beyond the neutral point, whence they will fall towards the moon, just to the neutral point, where they will remain forever, or whether, the velocity being insufficient, they will fall back to earth. Observation shows them that the projectile is going too far to the north, instead of heading for the center of the moon, but these observations are interrupted because the oxygen-making apparatus has inadvertently been left on, and the men become drunk on oxygen, eventually falling into a stupor. Nicholl, fortunately, turns the stopcock in time, and they are saved.

As the projectile mounts toward the moon, all objects within it lose weight, until at the neutral point, 47/52nds of the distance from the earth, none is left. At this point objects left in the air remain suspended. Ardan pours out three glasses of wine, placing them in space before his companions, and they drink to the critical passage. Then, as the projectile commences its fall to the moon, it slowly turns around until its heavy base points moonward, and the suspended objects once more descend to their accustomed positions.

Further discussion ensues. Barbicane points out that on the moon a

two-hundred-pound object would weigh only thirty pounds, and that if Ardan can jump a meter on earth, he will be able to jump 18 feet on the moon. If the size of the inhabitants is in proportion to the mass of the planet, they would be Lilliputians, less than a foot high. He also discusses weights on Jupiter and the sun, and the supposed enormous sizes of their inhabitants. From this pleasant conversation they turn to the serious business of protecting themselves from the fall to the moon's surface. In the interior they rearrange the platform that aided their departure, though this time there will only be steel springs instead of water, while on the outside they place the twenty rockets that are to retard the fall.

The fall to the moon, however, does not take place. The influence of the earth's second satellite has turned them northwards, and for three days they circle the moon, observing Copernicus, Plato, an active volcano on the moon's other side, and a brilliant meteor a mile and a quarter in diameter which explodes just before meeting the projectile. In the meantime, they take advantage of the moon's shadow to throw a thermometer into space and withdraw it after thirty minutes, thus discovering the temperature of space to be minus 140° C. They are concerned as to whether the projectile will follow a parabola or hyperbola, but the orbit turns out to be elliptical. As an object moving in an ellipse passes through every point it has previously occupied, the projectile is carried back to the neutral point. There the travellers set off the rockets in a vain attempt to fall to the moon, but their momentum is too great and their fall to the earth commences. Fortunately for them their fall is into the sea, and the ocean absorbs the shock of their fall which is at the rate of 56,000 feet per second. The projectile floats, and their marvelous voyage is brought to a successful termination when they are rescued by a naval vessel.

1800 Albemarle Road, Brooklyn, New York.

Planet Notes for September and October, 1942

By R. S. ZUG

Note: Greenwich Civil Time is employed unless otherwise stated. To obtain Eastern Standard Time subtract 5 hours, Central Standard Time, 6 hours, etc. The planetary phenomena are described as they are to be seen from latitude 45° N. The data are taken chiefly from *The American Ephemeris and Nautical Almanac.*

Sun. Apparent positions of the sun are as follows:

	α h m	δ ° ′
Sept. 1	10 38.4	+ 8 35.9
Oct. 1	12 26.4	— 2 51.1
Nov. 1	14 22.3	—14 9.4

The sun leaves the constellation Leo on September 16 to enter the constellation Virgo. It passes from the latter into the constellation Libra on November 1.

The season of autumn begins September 23, $16^h\ 17^m$, when the sun reaches the autumnal equinox.

Moon. Phenomena of the Moon will occur as follows:

		h	m
Last Quarter	Sept. 2	15	42
New Moon	10	15	53
First Quarter	17	16	56
Full Moon	24	14	34
Last Quarter	Oct. 2	10	27
New Moon	10	4	6
First Quarter	16	22	58
Full Moon	24	4	5
Apogee	Sept. 4	6	
Perigee	19	3	
Apogee	Oct. 2	1	
Perigee	14	5	
Apogee	29	21	

Eclipses. A partial eclipse of the sun will occur on September 10, visible over North Africa, Europe, the North Atlantic, and the North Polar Region. For further details of the eclipse, refer to POPULAR ASTRONOMY, January, 1942, p. 38.

Mercury. Mercury reaches greatest elongation on September 15, and will therefore be situated in the evening sky, but the planet will probably be quite inconspicuous at that time because of its low altitude at sunset. It reaches inferior conjunction on October 11, and thereafter will be situated in the morning sky, but too near the sun for easy location until after November 1.

Venus. Venus is in the morning sky and is drawing nearer to the sun in apparent motion. On October 23, 13^h Venus will be in conjunction with, and 45′ to the north of, the planet Mars. This phenomenon may be observed telescopically by those interested during the morning and afternoon (U.S.A.) of October 23. Data concerning Venus, of interest to observers, are tabulated below:

Date 1942	Distance from Earth in miles	Angular Diameter	Fraction of disk seen illuminated	Stellar Magnitude
Sept. 7	148,913,000	10″.5	0.95	—3.4
17	151,743,000	10.3	0.96	—3.4
27	154,100,000	10.2	0.97	—3.4
Oct. 7	155,997,000	10.0	0.988	—3.4
17	157,429,000	9.9	0.994	—3.4
27	158,420,000	9.9	0.996	—3.5

Mars. Mars will be inconspicuously situated in the early evening sky during September and the first week in October. Conjunction occurs on October 6, when the planet becomes a morning object. It will remain too close to the sun to be seen with the unaided eye during October.

Jupiter. Jupiter is a morning object. Western quadrature will be attained on October 18.

Saturn. Saturn reaches western quadrature on September 5.

Uranus. September and October will be good observing months for Uranus. Apparent positions of the planet are as follows:

		α h	m	δ °	′
Sept.	1	4	10.4	20	53.6
Oct.	1	4	9.9	20	52.1
Nov.	1	4	6.3	20	42.5

Neptune. Neptune will be in conjunction on September 23.

Asteroid Notes

By HUGH S. RICE

Vesta is the most satisfactory asteroid to observe primarily because of its brightness and the fact that its orbit is so well known that the resulting ephemerides are computed with high accuracy. The asteroid is in a good position for observation this summer, and should be picked up without difficulty with the aid of binoculars. Indeed its maximum brilliance at this apparition, of magnitude 6.1 in July, places it within the range of naked-eye visibility for good eyes and exceptional atmospheres. But it is gradually getting dimmer. We wonder if anyone will have seen it with the unaided eye, by the end of the summer.

From our position on the eighth floor of an apartment house in the Spuyten Duyvil section of New York City, we have been observing Vesta while inside the butterfly configuration of Capricornus. Observation has been from indoors looking out, there being no point in going outdoors to observe under the present conditions. The asteroid has been found exactly in its predicted place, as far as can be determined with the instrument used, the 18x Zeiss binoculars. The magnitude follows prediction; and the asteroid *appears* not to scintillate as much as the surrounding stars. The aperture and sky have not yet allowed confirmation of the characteristic orange-pink color which we have seen repeatedly in Vesta with larger telescopes. No difficulty was experienced in locating the object on nights when the atmosphere was so bad that the only naked-eye stars seen in Capricornus were Alpha and Beta.

Practically the only difficulty in observing the brighter asteroids, especially at present, is concerned with knowing the whereabouts of the objects. If one can obtain ephemerides and the proper charts on which to plot the apparent path, the main difficulties vanish. Large-scale charts have to be used for good work. Comparatively few persons have all the proper charts needed, different ones being used in different cases. In the present instance, the asteroid promptly runs off the Beyer-Graff series, as well as the Schönfeld charts. The best ones to use here are the excellent Córdoba series of the southern hemisphere. Upon this we have plotted the positions for the summer, from which the following should help observers to locate the planet with the aid of smaller atlases like Norton's Star Alas, Schurig's Himmels-Atlas, or Stuker's Stern-Atlas.

The key-star for locating Vesta at present is 17 Capricorni. On August 1 (at 0^h U.T.) Vesta is about 3¾° roughly southwest of 17 Capricorni. More exactly, the position-angle—in double-star terminology—is 230°. From this place it moves to its stationary point on September 10, about 9½° from the same star nearly in the same direction, or position-angle 237°. From this stationary point it (nearly) backtracks by a distance of 2° by October 2. The magnitude on August 1 is 6.1; on September 10, 6.5; on October 2, 6.9. There are some double stars and interesting configurations near its track during this period. In early August there are two sets of two stars each, on either side of Vesta's path, the stars being slightly fainter than the asteroid. A brief ephemeris covering these positions may assist the observer who wants the coordinates; it is adapted from computations by the British Astronomical Association. At 0^h U.T. on August 1, R.A. is $20^h\ 30^m6$ and Dec.—24° 5′; on September 10, R.A. $20^h\ 7^m6$ and Dec.—26° 35′; on October 2, R.A. $20^h\ 15^m5$ and Dec. —26° 12′.

Hayden Planetarium, American Museum of Natural History, New York, July 19, 1942.

Occultation Predictions for September and October, 1942

(Taken from the *American Ephemeris*)

Date 1942	Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION *a*	IMMERSION *b*	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION *a*	EMERSION *b*	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Occultations Visible in Longitude +72° 30′, Latitude +42° 30′										
Sept. 1	BD+12°477	6.2	3 11.4	+0.2	+1.6	72	4 9.8	−0.1	+1.6	252
1	*f* Tau	4.3	4 59.9	−0.6	+1.5	90	6 3.9	−0.6	+2.2	229
2	48 Tau	6.4	3 24.0	+0.9	+3.1	11	3 48.1	−0.3	−0.4	320
2	γ Tau	3.9	5 14.7	+0.3	+3.0	25	5 58.4	−1.1	+0.4	301
2	70 Tau	6.4	8 33.6	−1.4	+2.2	57	9 58.1	−2.1	+0.3	268
2	θ^1 Tau	4.0	10 37.2	−2.3	−0.5	100	12 2.0	−1.9	+0.9	235
2	θ^2 Tau	3.6	10 49.3	−2.6	−2.5	126	11 50.3	−1.7	+2.9	209
17	90 B.Oph	6.5	1 38.8	−0.8	−0.7	69	2 39.2	−0.8	−1.9	296
19	171 B.Sgr	6.1	3 12.8	−0.8	−0.4	60	4 14.4	−0.8	−1.6	282
19	173 B.Sgr	6.3	3 32.1	+0.1	+1.4	21	4 4.7	−1.6	−3.5	321
21	94 B.Cap	6.0	0 27.3	−1.8	+0.7	85	1 45.7	−1.7	+0.6	245
27	389 B.Cet	6.3	10 15.0	−1.0	+0.4	49	11 19.3	−0.7	−1.8	278
28	BD+11° 445	5.9	3 58.2	−1.1	+1.6	84	5 9.4	−1.0	+2.1	231
29	179 B.Tau	6.0	8 59.0	−2.2	−0.7	99	10 20.9	−1.8	+0.8	234
30	318 B.Tau	5.7	8 37.3	−2.0	+1.0	75	10 8.6	−2.1	−0.2	263
Oct. 4	BD+16° 1662	6.1	5 28.2	+0.2	+1.1	96	6 26.9	−0.1	+1.3	268
16	266 B.Sgr	6.1	20 29.5	−1.8	+2.3	40	21 23.6	−1.6	−0.6	313
19	σ Aqr	4.9	22 44.8	..	..	140	23 10.9	..	..	181
27	70 Tau	6.4	0 25.0	+0.4	+1.8	55	1 19.1	−0.2	+1.2	275
27	θ^1 Tau	4.0	1 46.0	−0.4	+1.4	93	2 47.5	−0.4	+2.1	234
27	θ^2 Tau	3.6	1 52.9	−0.8	+0.6	118	2 38.8	0.0	+2.9	208
27	264 B.Tau	4.8	2 52.5	−0.7	+1.9	73	4 5.5	−1.1	+1.6	253
27	275 B.Tau	6.5	4 46.3	−1.8	+0.9	95	6 5.4	−1.6	+2.0	232
27	α Tau	1.1	6 22.7	−2.2	+0.4	89	7 51.0	−2.0	+0.8	243
28	115 Tau	5.3	6 51.7	−2.3	−0.3	106	8 15.2	−2.0	+1.4	236
29	19 B.Gem	6.2	4 15.6	−0.4	+2.5	54	5 20.9	−1.4	+0.5	289
31	3 Cnc	5.8	8 23.6	−1.9	+0.8	93	9 54.1	−2.1	−0.5	283
Occultations Visible in Longitude +91° 0′, Latitude +40° 0′										
Sept. 1	*f* Tau	4.3	4 52.0	0.0	+1.5	82	5 51.4	−0.2	+1.8	242
2	γ Tau	3.9	5 18.4	+1.0	+3.7	8	5 41.2	−0.8	−0.9	322
2	70 Tau	6.4	8 10.2	−0.5	+2.8	42	9 17.8	−1.8	+0.6	282
2	71 Tau	4.6	8 40.0	..	..	142	9 7.3	..	..	182
2	θ^1 Tau	4.0	9 55.5	−2.0	+0.9	89	11 22.2	−1.9	+1.7	237
2	θ^2 Tau	3.6	10 3.0	−2.6	−0.4	114	11 11.8	−1.5	+3.1	213
2	264 B.Tau	4.8	11 27.5	−2.1	+1.1	70	13 0.1	−2.2	−0.3	263
2	α Tau	1.1	15 27.4	−1.4	+0.6	46	16 23.8	−0.4	−2.9	305
17	90 B.Oph	6.5	1 17.7	−1.5	−0.2	66	2 24.0	−1.5	−2.0	303
19	171 B.Sgr	6.1	2 53.1	−1.3	+0.4	48	3 56.0	−1.7	−1.8	296
20	94 B.Cap	6.0	23 56.4	−1.3	+1.2	89	1 10.3	−1.6	+1.2	250
27	389 B.Cet	6.3	9 48.4	−1.6	+1.0	48	11 3.6	−1.6	−1.3	271
28	BD+11° 445	5.9	3 42.7	−0.3	+1.7	73	4 48.2	−0.6	+1.8	246
29	179 B.Tau	6.0	8 16.8	−2.2	+0.7	89	9 43.1	−1.9	+1.6	234
30	318 B.Tau	5.7	8 1.3	−1.4	+2.0	65	9 27.4	−2.1	+0.7	265
Oct. 13	24 Sco	5.0	23 59.8	−1.1	+0.1	52	0 51.0	−1.4	−2.5	320
16	130 B.Sgr	6.5	1 30.9	−1.2	−0.3	67	2 39.9	−1.2	−1.4	278
19	σ Aqr	4.9	22 25.8	..	..	148	22 44.2	..	..	180
27	θ^1 Tau	4.0	1 41.8	+0.2	+1.3	84	2 38.8	0.0	+1.7	246
27	θ^2 Tau	3.6	1 45.3	0.0	+0.9	107	2 34.3	+0.2	+2.2	223
27	264 B.Tau	4.8	2 42.8	0.0	+1.9	60	3 44.7	−0.6	+1.3	267

Date 1942	Star	Mag.	IMMERSION Greenwich C.T.	*a*	*b*	Angle E from N	EMERSION Greenwich C.T.	*a*	*b*	Angle E from N
			h m	m	m	°	h m	m	m	°
27	275 B.Tau	6.5	4 19.6	—0.9	+1.7	80	5 33.8	—1.1	+1.8	245
27	α Tau	1.1	5 46.4	—1.5	+1.6	76	7 11.3	—1.8	+1.4	249
28	115 Tau	5.3	6 14.6	—1.7	+1.0	96	7 35.1	—1.6	+1.9	239
29	19 B.Gem	6.2	4 9.8	+0.4	+2.7	40	4 57.6	—0.9	+0.2	303
31	3 Cnc	5.8	7 52.8	—1.2	+1.2	94	9 15.4	—1.7	+0.8	273
	OCCULTATIONS VISIBLE IN LONGITUDE +120° 0′, LATITUDE +36° 0′									
Sept. 2	70 Tau	6.4	8 2.4	+0.8	+3.6	13	8 32.8	—1.2	—0.7	314
2	71 Tau	4.6	8 1.7	—0.3	+0.8	108	8 53.4	0.0	+2.5	219
2	θ^1 Tau	4.0	9 14.9	—0.5	+2.0	65	10 27.4	—1.2	+1.4	259
2	θ^2 Tau	3.6	9 14.7	—0.7	+1.4	87	10 24.9	—0.9	+2.1	237
2	264 B.Tau	4.8	10 35.0	—0.9	+2.6	48	11 51.1	—2.1	+0.6	275
2	275 B.Tau	6.5	12 38.0	—2.2	+1.3	73	14 13.8	—2.4	+0.5	255
2	α Tau	1.1	14 29.1	—2.3	+1.0	64	15 58.9	—2.1	—1.2	275
4	BD+18° 1112	6.4	11 0.0	—1.7	—1.0	136	11 41.8	—0.1	+4.2	205
19	171 B.Sgr	6.1	1 54.0	—2.2	+1.8	48	2 59.3	—2.2	—1.1	308
19	190 B.Sgr	5.4	4 53.0	—1.8	—0.4	82	6 9.5	—1.3	—0.7	258
22	e Aqr	5.4	9 0.7	—2.0	—2.4	118	9 44.2	0.0	+1.9	196
27	389 B.Cet	6.3	8 57.6	—1.0	+3.3	22	10 3.8	—2.9	—0.8	285
29	179 B.Tau	6.0	7 31.2	—0.7	+2.0	64	8 45.7	—1.3	+1.4	256
30	318 B.Tau	5.7	7 33.3	0.0	+2.6	41	8 31.3	—1.3	+0.5	288
Oct. 16	130 B.Sgr	6.5	0 36.9	—2.2	+1.0	62	1 53.8	—2.3	—1.0	294
19	151 B.Cap	6.1	6 12.3	—0.6	+1.5	26	7 7.8	—1.8	—1.9	287
27	275 B.Tau	6.5	4 5.9	+0.2	+1.7	61	5 4.5	—0.4	+1.2	267
27	α Tau	1.1	5 17.4	—0.1	+2.2	53	6 21.3	—1.0	+1.0	273
28	115 Tau	5.3	5 45.0	—0.2	+1.6	74	6 51.8	—0.7	+1.4	259
31	3 Cnc	5.8	7 31.4	0.0	+1.4	83	8 35.6	—0.6	+0.9	278

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result in degrees, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

METEORS AND METEORITES

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

In August will come the rich annual Perseid shower, under good conditions as to moonlight. It is urged that all our members make real efforts to observe on several nights during its continuance. Meteor rates should be high so one is likely to have more to show for a night's observing. We also ask that at all times fireball reporting be not neglected. Maps and blanks for all types of our work are ready to be sent to our members on request, but requisitions should come in early to insure arrival on time.

The following notes consist of results on three bright fireballs, two of which

appeared 20 years ago and one early this year. There has been a steady effort here to clear up the numerous unfinished cases in our files and the two mentioned are among the oldest.

Fireball of 1922 May 28

During the month of May, 1922, three brilliant fireballs were observed at the University of Virginia, where I then was. One of these was fully worked up by me and the results published (Popular Astronomy **33**, 502, 1925). Some work was done on the other two but the data seemed insufficient or somewhat contradictory so that they were laid aside. Recently, with 20 years of added experience in handling such cases, I have restudied both sets of reports. The one seen at 10:28 p.m., May 28, is discussed here. The solution is not fully satisfactory but is enough so to put the results on record, as the body was a brilliant one. Thirty-six reports are available, nearly all consisting of original letters, due to newspaper publicity, and questionnaires then sent to the writers which were filled out and returned to me. The rest were due to personal conversations with observers. Except for those at Charlottesville, Virginia, where the University of Virginia is situated, no one used the stars as reference points so the other reports are based upon mere estimates. As usual, many of the observers did not understand angular measurement. Also they were rather bunched in the region over which the fireball began, quite a few reporting a vertical or almost vertical path. This was true of the five at Charlottesville who agree fairly well. Only by giving special weight to this set was I able to derive a solution, but this procedure was fully justified. Unfortunately, we have no definite report from West Virginia, over which state most of the path lay and over which it ended. A study of the reports indicate that the fireball started as a body of at least 5′ in apparent diameter, and that the head was red or yellow in color. It was followed by a short conical tail in which other colors appeared. At its explosion it turned whiter or bluer, more or less the color of an arc light. It is difficult in some cases to untangle the meaning of the observers as to whether they reported the explosion point or the end point. The former was certainly well above the horizon to everyone, unless some mountain or other objects impeded the view. Many distinctly say that it disappeared over the horizon. What I have then done is to derive the height and position of the explosion point, and, using this along with the position of the beginning point, I have extrapolated for the point where the fireball would have landed had it kept on a straight course after exploding. As the explosion point was high, one may well doubt if meteorites fell, though, to satisfy the reports, bright fragments must have gone somewhat farther before being extinguished. Omitting two absurdly great estimates of 200? and 45 seconds for the duration, the rest range from 15— to 2+, the average of 25 being 6.00 seconds. The better observers would average nearer 4 seconds. Most estimates of size probably refer to how it appeared at explosion and would give a value of from one half of to equality with the full Moon. No train was left, for the short conical tail is not a "train," I believe, in the usual sense. No explosion was heard by most observers, though some "sounds" or "swishing" were reported as heard within a few seconds. In this case, I think we are safe in saying these were purely psychological and based upon expectation. Belated appreciation is here expressed to the papers and to the numerous people who aided in gathering the data. Parabolic heliocentric velocity is assumed in deriving the zenith correction, as no confidence can be placed in the observed velocity.

Date	1922 May 28, 10:28 P.M., E.S.T.
Sidereal time at explosion point	218°—
Began over	λ 79° 12′ W, φ 38° 22′ N, at 126 km
Exploded over	λ 80° 13′ W, φ 38° 48′ N, at 38 km
Ground point	λ 80° 39′ W, φ 39° 01′ N, at (0) km
Length of path (to explosion point)	133 km
Projected length of same	99 km
Observed velocity (25 observers)	22 km/sec
Observed velocity (better observers)	33 km/sec
Radiant (uncorrected)	a = 300°, h = 42°
Zenith correction	—1°
Radiant (corrected)	a = 300°, h = 41°; α = 259°, δ = +7°

Though the coordinates of the radiant are subject to some uncertainties, I suggest comparison with fireballs Nos. 185, 549, and 551 in the von Niessl-Hoffmeister Catalogue.

Fireball of 1922 May 30

This is the third of the three fireballs mentioned above and it came at about 8:45 P.M., the whole path being over West Virginia and the direction of motion from south to north. Altogether I have 16 reports, of which 5 were collected by Professor Arthur M. Miller, Department of Geology, University of Kentucky. When Professor Miller found that I was working on the fireball, he kindly sent these reports to me. A somewhat pessimistic article on the subject by him appeared in September in *Science*, NS **56**, 249, 1922. In this he mentions reports from other states as having come to him, but these reports were never sent to me. He was able to come to no definite results.

In our case, we were fortunate in having an observation from M. W. Venable, Civil Engineer, who was in camp near Glade Creek, West Virginia, S1, and who reported the meteor passing over in the direction towards a = 185°. He sent a topographical map with the path plotted so there is no doubt about the observation. Also at Charlottesville, Virginia, I was able to interview my friend, the late Dr. John Neff of the University of Virginia, S15, who, along with three others, saw it; and Macdonald Dick, S16, a student, who used both the Moon and Venus as reference points. Two or three others also used the Moon, then not high in the west, and this fact greatly added to the possibility of a solution. Only one apparently good observation had to be partly rejected, that from Covington, Virginia, S5, where the statement was made that the meteor started *under* the Moon; this must have been *over* or all the other observations would have been grossly incorrect. The end point for S5 agreed with others, but the letter containing this observation was written 21 days after the event, which means many chances for forgetting, or indeed the word *under* may have been inadvertently typed for *over*. From S15 and S16 the apparent diameter was given as about ¼ that of Moon and the brightness at explosion as being greater than that of the full Moon. The color is variously described but the best evidence is greenish yellow. As with the fireball two nights before, it was followed immediately by a bright tail, green this time, but no train in the usual sense was left. There are only six estimates of velocity; leaving out an exaggerated one of 30 seconds, the other five give an average of 8.4 seconds. This value I consider extremely uncertain. It only indicates that the relative velocity was low. However, as usual, parabolic heliocentric velocity was assumed in deriving the zenith correction.

The Virginia observers, who were on an average distant more than 200 km

from the fireball's path, did not hear explosive sounds. These were pronounced over West Virginia. The best description of the fireball's disintegration comes from R. S. Cook at Ivy Depot, Virginia, S13, who says: ". . . It seemed to pass a few degrees under the moon and was traveling in a northern direction, making about 30°-35° with horizon. At about 45°* from the horizon it seemed to partly disintegrate and the smaller pieces followed in its path; the main body of it continued until . . . (disappeared behind woods)." At S1 ". . . It burst with a tremendous roar similar to a salvo of artillery, and with a brilliance almost blinding, and dissipated itself in a bright shower of sparks. . . No shock was felt." This seems to have been the disintegration point, but the rest of the object, as seen by distant observers, kept on for about 50 km more, in fact the explosion point seems to have been not far from the middle point of the path. In general violent sound phenomena were reported from the West Virginia stations. The fireball must certainly have been visible from northeast Kentucky and eastern Ohio, but no reports reached me from either. This indeed was 20 years ago when the public was far less "meteor conscious," but we find the same apathy today and an ignorance on the part of most of the best educated people on what to record and what to do with the reports. For every fireball it is necessary to make a prompt appeal through the newspapers for observations or we are still liable to receive only one or two. And yet in the past two decades there has been an immense amount of publicity on the general subject, as the papers are very generous in their aid.

With regard to the data derived for this fireball, I believe that the height of the beginning point is about correct, but am inclined to think the ending point is probably a little lower than given. There is more uncertainty in the azimuth of the path as it depends so largely upon the observation at S1. This would mean that the right ascension of the radiant is more uncertain than its declination. In the von Niessl-Hoffmeister Catalogue, comparison should be made with No. 162, but the long interval of 53 years between probably means mere accidental similarity. The results are as follows:

Date	1922 May 30, 8:45 P.M., E.S.T.
Sidereal time at end point	194°—
Began over	81° 05′ W, 37° 10′ N; at 103 ± 4 km, 4 Obs.
Ended over	80° 55′ W, 38° 31′ N; at 38 ± 16 km, 3 Obs.
Length of path	165 km
Projected length of path	151 km
Observed velocity	20 km/sec
Radiant (uncorrected)	$a = 5°$, $h = 23°$
Zenith correction	—9°.1
Radiant (corrected)	$a = 5°$, $h = 13°.9$; $\alpha = 187°$, $\delta = -37°$

FIREBALL OF 1942 MARCH 7

A fine fireball crossed the central part of New York at about 7:18 E.S.T., on 1942 March 7. By good fortune this was observed by C. M. Smith, regional director for that district, and at once requests for reports were published by him in local newspapers which as usual heartily cooperated. As a result 54 persons sent in letters or were interviewed in person. Questionnaires were then sent to 20 of the most promising observers, which were filled out and returned with additional information. The gathering, arranging, and partial reductions were all

*Note by C.P.O.—Moon was then only 25° high so that the estimate of 45° should be cut to less than half.

done by Smith, and a preliminary path worked out by him, which is quite close to the one given here. The data were then sent to Flower Observatory and the final results worked out by me.

The object was a brilliant one and while there is the usual lack of agreement as to its color, on the whole blue-white seems that decided upon by the more reliable observers. It exploded or at least had a very great increase in brightness at the end of its path. Its brightness was estimated at from several times brighter than Venus to equality with the full Moon. A fair average would be perhaps —6 or —7 magnitude. There was no long-enduring train left, nor indeed any whatever according to most observers, nor was any explosion heard. Again we have uncertain reports from a few who believe their attention was attracted to the fireball by *hearing* it, as they would have a rocket. The reality of this phenomenon will not be further discussed here. According to our results the ending point was over Lake Ontario though only a few miles from shore. However, the considerable height of the ending point, which is based upon 10 estimates with not too great an internal deviation, gives little reason to believe that meteorites fell. The beginning height is based upon 7 estimates.

With regard to the observations themselves, all made in central New York, unfortunately only Smith himself sent in a plot with regard to the stars. Although the fireball must have passed not very far above Polaris, which is known to more people than are most stars, we have no attempt to fix the path by it. Hence the estimates are "dead reckonings" or at least points fixed by natural objects whose altitudes and azimuths were measured or estimated some days later. An examination of the plots made here indicates that the radiant is quite well determined. It hardly seems possible that the coordinates could be wrong by as much as 5°, probably considerably less. Parabolic heliocentric velocity was assumed in deriving the zenith correction. We are under great obligations to the newspapers which published requests for observations and to the individuals, too numerous to mention by name, who took the trouble to report. The usual data follow:

Date	1942 March 7, 7:18 P.M., E.S.T.
Sideral time at end point	95°—
Began over	72° 12′ N, 43° 03′ W; at 104 ± 24 km
Ended over	77° 01′ N, 43° 20′ W; at 55 ± 17 km
Length of path	158 km
Projected length of path	151 km
Duration	3.9 ± 1.35 sec (15 estimates)
Relative velocity	41 km/sec
Radiant (uncorrected)	a = 282°, h = 17°.9
Zenith correction	—3°.7
Radiant (corrected)	a = 282°, h = 14°.2; α = 166°, δ = +1°

Flower Observatory of the University of Pennsylvania, Upper Darby, Pennsylvania, 1942 June 30.

Contributions of the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD
Department of Astronomy, University of California, Los Angeles

President of the Society: LINCOLN LA PAZ, Department of Mathematics, Ohio State University, Columbus

Secretary of the Society: C. H. CLEMINSHAW, Griffith Observatory, Los Angeles, and Department of Astronomy, University of Southern California, Los Angeles

The Aerolitic Fall of Rancho de la Presa, Zenapecuaro, Michoacan, Mexico

By H. H. NININGER
Colorado Museum of Natural History and American Meteorite Laboratory, Denver

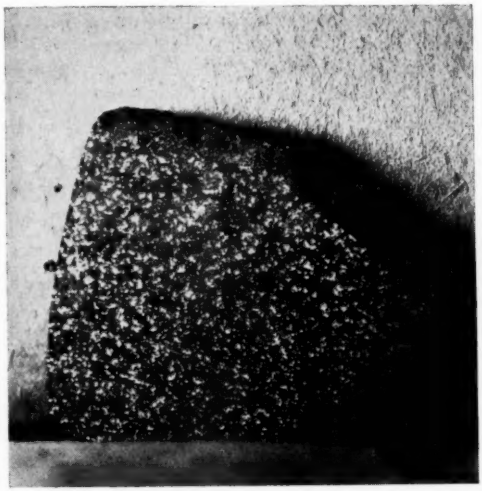
ABSTRACT

An investigation made in 1929 brought to light the following facts concerning the aerolite of Rancho de la Presa, Zenapecuaro, Michoacan, Mexico. This stone was seen to fall in 1899—the exact date of the fall is unknown—by two Mexican women. The original weight of the meteorite was above 300 g. The main mass is preserved in the State Museum at Morelia, the capital of Michoacan, while 63 g. are in the Institute of Geology at Mexico City and 3 g. are in the Field Museum of Natural History at Chicago, Illinois. The aerolite should be classified probably as a brecciated, veined, gray chondrite.

In O. C. Farrington's "Catalogue of the [Field Museum] Collection of Meteorites," published in 1916,[1] and in his "Catalogue of the Meteorites of North America, to January 1, 1909," published in 1915,[2] mention is made of a stony meteorite (aerolite) from Rancho de la Presa, District of Zenapecuaro, Michoacan, Mexico. G. T. Prior also mentions this meteorite in his catalogue of 1923.[3] As far as is known to the writer, all of these references were based upon the meager reference to this meteorite made in H. A. Ward's "Catalogue of the Ward-Coonley Collection of Meteorites" (p. 86), published at Chicago in 1904. All of these sources credit the Field Museum with possessing 3 g. of this fall, but no other mention seems to be made of the size of the aerolite. Both Prior's catalogue of 1923 and Farrington's of 1916 list it as a fall of 1899, while in Farrington's "Catalogue to 1909" it is mentioned as "Found 1899." In view of these incomplete references to this meteorite, it seemed desirable that a more complete record be made of it. Accordingly, the writer and Mr. Alex Richards, while making a survey of the meteorites of Mexico in 1929, made a special effort to gather more data regarding this fall.

Our efforts were rewarded first by the finding of 63 g. of the meteorite in the Institute of Geology in Mexico City and second by the good fortune of learning through the National School of Mines of Mexico that the original weight of the recovered portion of this fall was above 300 g. and that this small stone was seen to fall in the year 1899—the exact date was not recorded—by two Mexican women who were walking along a footpath on the ranch whose name the meteorite bears. Their story was that, as they were walking along, they were attracted to what

they thought was a dead bird, falling to the ground near them. When they went to pick the thing up, they found that it was a warm, black stone. This fact was thought to be a matter worthy of the priest's attention, to whom they took the stone and recited their story. Fortunately, the priest made it a point to report the event and to transmit the specimen to a geologist in Mexico City, who saw to it that a fragment was kept for the mineral cabinet of the Institute of Geology. As for the remainder of the stone, we could find no one in Mexico City who knew of its whereabouts. It seemed logical to suppose, however, that a portion of the mass had been retained in the State in which it fell, and, accordingly, a visit was made to Morelia, the capital of the State of Michoacan. Here our efforts were again rewarded by finding that the main mass was preserved in the State Museum, presided over by Dr. Martinez Baes, through whose generosity we were permitted to section the stone and to make such studies as seemed advisable.



A Section of the Rancho de la Presa Aerolite
(Natural Size)

Upon sectioning, this small aerolite was found to be pronouncedly brecciated and richly chondritic. It should be classified probably as a brecciated, veined, gray chondrite. The accompanying photograph shows well the distribution of the nickel-iron grains within the stone.

References

[1] *Field Mus. Nat. Hist., Publ.* **188**, *Geol. Ser.*, **3**, No. 10, 291, Chicago, 1916.
[2] *Mem. Natl. Acad. Sci.*, **13**, 366, Washington, 1915.
[3] *Cat. Meteorites, Brit. Mus. (Nat. Hist.)*, 147, London, 1923.

The Compressive Strength of Meteorites

By JOHN DAVIS BUDDHUE
99 S. Raymond Av., Pasadena, California

ABSTRACT

Altho the compressive strength of meteorites is important in relation to the detonation of meteorites in flight and probably in other connections in meteoritics, only one determination of it existed prior to this study. The compressive strength of 8 stones, ranging from 900 to 54,000 lb./in.², is reported.

In the fall of a meteorite, the pressure of the air on its front surface may reach a very high value. The magnitude of this pressure depends upon several factors, but it tends to produce fragmentation of the meteorite. In a list of 1336 meteors,[1] I find 286, or 21.4%, which detonated. Detonation has been observed repeatedly to occur simultaneously with the disruption of the mass. Fragmentation will obviously not occur unless the stress exceeds the strength of the meteorite. Since the stress is chiefly compression, one of the factors determining whether a detonation will occur must be the compressive strength. This datum is concerned also in the breakage of a meteorite on striking the Earth or some other solid body.

In spite of the importance of the compressive strength, the only information that I can find concerning it is Burkart's determination for wire forged from the Descubridora, Mexico, iron.[2] In order to increase our knowledge on this point, I have determined the compressive strength of the 8 stones enumerated in the following table.

Meteorite	lb./in.²	kg./cm.²
(1) Holbrook, Arizona	900	63
(2) Covert, Kansas	10,934	768
(3) Ness County, Kansas	12,025	844
(4) Morland, Kansas	23,150	1,627
(5) Alamogordo, New Mexico	39,100	2,740
(6) Kimble County, Texas	46,600	3,270
(7) Arapahoe, Colorado	51,010	3,580
(8) La Lande, New Mexico	54,250	3,810
(9) Descubridora, Mexico (iron)	54,000	3,800

I used an Olson universal testing machine, and the load was applied at the rate of 0.05 inch per minute. The Morland specimen contained a crack, but this was so placed that its effect was the same as tho 2 specimens had been tested simultaneously; that is, it was placed parallel to the load. Therefore, it should not have had any great effect upon the reading. A second specimen of Kimble County failed at 25,000 lb./in.² by splitting off a chip at one end. A complete failure occurred at a reading corresponding to 27,000 lb., but, as the loss of the chip had materially reduced the cross-sectional area, the true load must have been at least half again as great. A second specimen of Arapahoe was tested with the load applied at the rate of one inch per minute. The machine shut off automatically at 58,800 lb./in.² without producing failure. However, before the machine could be reversed, the specimen shattered with a loud report.

The sounds produced at failure were related in a general way to the compressive strength. Holbrook failed with a slight crunching noise. Covert and Ness County made louder crunching noises. The remainder literally burst with loud reports and would have thrown fragments to considerable distances, had not

precautions been taken to prevent them from doing so. In the case of Arapahoe, the second specimen made more noise than the first.

It will be recalled that the very weak Holbrook fall produced an enormous number of fragments (upwards of 14,000). The comparatively weak Covert and Ness County falls produced 10 and 25 stones, respectively. Only one mass of each of the other falls is known, except in the case of Alamogordo, which seems to have been recovered in the form of fragments produced either by weathering or by impact with the Earth.

My thanks are due to Dr. Virgil E. Barnes of the University of Texas for supplying me with the Kimble County stone, and to the Plastics Institute, 186 S. Alvarado St., Los Angeles, California, for the use of their testing machine.

REFERENCES

[1] C. P. Olivier, *Proc. Am. Phil. Soc.*, **85**, No. 2, 93-135, 1942, and *Publ. Univ. of Pennsylvania, Reprint No. 60, Flower Astr. Obs.*, "Long Enduring Meteor Trains."

[2] Burkart, *Neues Jahrb. Min.*, pp. 22-8, 1874.

"Long-Enduring Meteor Trains" (Review)

A large-sized pamphlet bearing the title "Long-Enduring Meteor Trains" has been issued as *Reprint No. 60* of the Flower Astronomical Observatory of the University of Pennsylvania. The paper was presented by the Director, Dr. Charles P. Olivier, before the American Philosophical Society about a year ago, and is reprinted from Vol. 85, No. 2, pp. 93-135, January, 1942, of its *Proceedings*. It consists of about 40 pages of tables and about 3 pages of description and deductions.

Meteor trains are apparently self-luminous gas-clouds combined with fine dust. Those seen in daylight are due to the reflection of sunlight by the tiny dust particles that are left along the path of the meteor. However, the cause of trains remaining visible at night for many minutes has not yet been explained, and Dr. Olivier does not attempt to answer that question. His catalog of 1336 trains contains the largest existing collection of data on the subject and should be fundamental to future studies of currents in the Earth's upper atmosphere. Each of the listed trains either lasted at least one minute or, if shorter in duration, showed actual drift.

Except for the rare noctilucent clouds, meteor trains are the only means of determining wind-directions and velocities at heights above which sounding balloons can penetrate. Since observations from 2 different places are necessary for determining height, only a small proportion of the trains could be used for that purpose. The mean height of about 50 night trains was found to be 88 km., or 55 mi. The mean height of about 20 day trains turned out to be just one-half of this. These means represent very well those for the Kennelly-Heaviside layer at night and perhaps also in the day. Some meteors are first seen as high as 130 km., but the mean beginning height of persistent night trains is only 102 km. Many meteors disappear at a height of about 60 km., and bright ones even lower, but the mean height of the lower end of the night trains is 74 km. A satisfactory theory to explain the cause of night trains must explain why they are confined to this atmospheric layer, between 74 and 102 km.

A study of the drifts of trains shows no steady currents following or opposite to the Earth's rotation. The upper atmosphere seems to contain thin layers moving in different directions and with speeds varying from about 50 to 300 km. per hour.

The mean velocity for night trains is nearly 200 km. per hour, while that for day trains is only about 125 km. per hour. This fact seems to indicate a general increasing wind-velocity with height.

Even for persons who observe the sky often, few persistent trains will be seen in the course of a lifetime. Only rarely does a brilliant meteor leave a train. The meteor's path among the stars and the changes in the train at one-minute intervals should be noted, and, if possible, drawn on a star map. All such information will be gratefully received and acknowledged by Dr. Olivier.

C. H. CLEMINSHAW

An Extraordinarily Large Meteor Seen in Texas, June 17, 1942

About 10:00 o'clock on the evening of June 17, I saw a meteor suddenly come into view at a point in the heavens near the base of the small triangle located about 20 degrees southeast of the lower star in the cup of the Great Dipper.

This was by all odds the largest and brightest meteor I have ever seen: it was approximately two-thirds as large as a full moon and, in color, was a blue-white, like some of the stars, Sirius for example, although it had a yellowish fringe around the rim, especially in front. It was almost circular and had a distinct rim, and showed no signs of going to pieces. Its movement was rather slow, for a meteor, as it took some 10 or 15 seconds to traverse an arc of some 30 degrees, and as it approached the earth its speed did not quicken, but it sank below the horizon like the setting sun. I was at first disposed to think that it was quite close, perhaps in this or in adjoining county, but when I noticed that its disk sank below the horizon without any change occurring, I thought that it might be somewhat farther away. Inasmuch as it did not explode or otherwise dissipate itself until it had come so near to the earth renders it probable that it was one of those rare meteors that reach the earth.

It was a splendid spectacle as seen from here in Austin, but to the inhabitants of those counties nearer to it, it must have been so grand as to be terrifying.

GEORGE B. HUFFORD.

Austin, Texas, June 29, 1942.

VARIABLE STARS

Variable Star Notes from the American Association of Variable Star Observers

By LEON CAMPBELL, Recorder

Light Curves for Long-Period Variables, IV: The fourth installment of the discussion of long-period variables here presented brings to 100 the number of variables for which new mean light curves have been derived. The data are listed in Table 1 in the usual form, and illustrated in the figure.

Of the 25 variables here discussed, 5 have light curves of the A class—maximum wider than minimum; 3 are of the B class—maximum equal to minimum; and 17 of the C class—minimum wider than maximum. Five stars present points of inflection, or still-stands, all occurring shortly after minimum phase has been attained.

Summarizing some of the features to be found in the discussion of these 100

variables, we find that 69 percent are of the Me spectral type; 10 of the Se type; 4 of M type; 3 of Ne type; and 1 of R type.

For 13 percent, no spectral types have, as yet, been determined, but if we can judge by the range of variation and shape of light curve, we may fairly safely assume that the majority of them belong to either the Me or Se types. Because most of these 13 stars are red and faint at maximum, it has not been possible to photograph their spectra. If these stars could be photographed by the large telescopes, the question of their spectral types would doubtless be settled.

TABLE 1

Design.	Name	No. Obs.	No. 10^d Means	A/D	M/m	Per. d	—Av. Dev.— Max. d	Min. d	Mag. Max.	Range M	Class
053337	RU Aur	423	180	0.76	0.36	466	7.7	8.8	9.7	4.4	Cb
053531	U Aur	947	349	0.58	0.48	408	6.6	7.4	8.5	5.4	Cb
054331	S Col	987	364	0.72	0.61	325	4.3	4.1	9.4	4.3	Cb
054615a	Z Tau	555	297	0.50	0.21	501	9.2	13.7	10.4	3.2	Cb
054615c	RU Tau	443	237	1.20	0.41	566	18.8	18.2	10.5	3.8	Cd
054629	R Col	870	279	0.60	0.42	327	5.7	5.0	9.1	4.9	Cb
054920a	U Ori	5702	506	0.51	0.75	373	8.9	9.6	6.6	5.3	Cb
054974	V Cam	896	311	0.44	0.29	520	9.2	6.4	10.2	4.8	Cd
055353	Z Aur	3160	619	0.88	2.06	111	6.2	7.4	9.9	0.8	Ab
055686	R Oct	1106	511	0.60	0.34	406	6.9	9.0	7.9	4.5	Cd
060450	X Aur	2974	562	1.20	1.46	163	5.8	4.3	8.7	3.7	Ac
061647	V Aur	778	336	1.08	0.95	353	7.8	7.2	9.2	2.8	Ad
061702	V Mon	1329	341	0.70	0.66	334	8.6	7.6	7.1	5.8	Cb
063159	U Lyn	688	328	0.62	0.46	438	8.6	12.1	9.7	4.6	Cd
063558	S Lyn	1349	483	0.53	0.47	301	4.8	7.3	9.7	4.4	Cb
064030	X Gem	1817	519	0.97	0.80	264	6.4	5.9	8.3	4.8	Ca
065111	Y Mon	825	352	0.91	0.75	230	5.2	7.2	9.2	4.5	Ca
065208	X Mon	2044	440	1.30	0.68	156	6.1	6.0	7.6	1.4	Ac
065355	R Lyn	2119	549	0.82	1.00	379	7.8	5.0	7.9	5.8	Bb
070109	V CMi	695	285	0.54	0.50	366	11.0	9.9	8.6	6.0	Cb
070122a	R Gem	4103	461	0.55	1.02	370	15.0	11.5	7.1	6.2	Bb
070310	R CMi	2361	488	1.03	1.36	338	5.6	5.5	8.1	2.8	Aa
070772	R Vol	679	342	0.76	0.58	445	12.7	12.4	10.6	2.6	Cb
071201	RR Mon	356	179	0.56	0.38	393	7.7	11.8	9.5	4.5	Cb
071713	V Gem	763	344	0.91	0.94	275	9.0	8.8	8.7	5.4	Ba
IV	*	1519	335	0.77	0.72	352	8.3	8.3	8.9	4.3	
I-IV	†	1647	409	0.84	0.86	322	7.4	7.8	8.9	4.5	

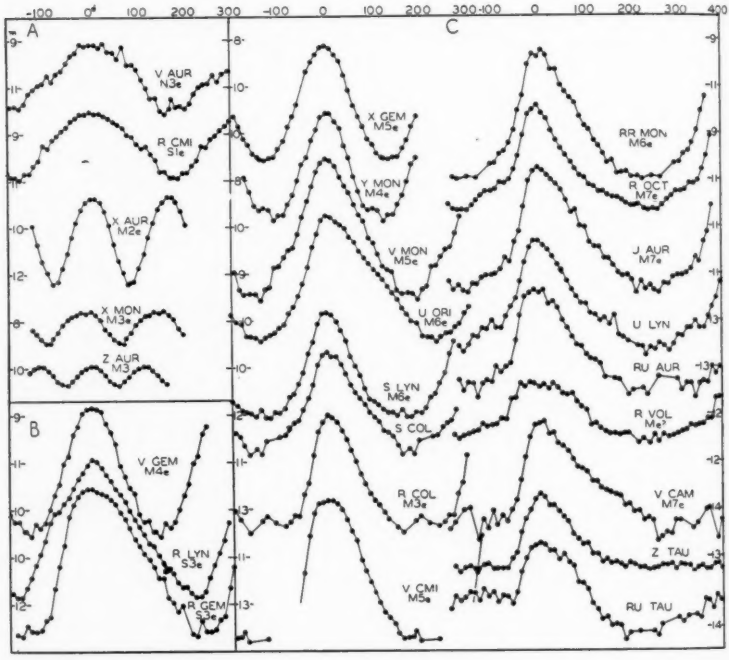
* 25 variables.
† 100 variables.

The average number of observations used in deriving the mean light curves of each of these 100 stars is 1,647, or a total of nearly 165,000, and the average number of ten-day means is 409, out of a possible 700. On the average, these stars occupy less time in increasing their light from minimum to maximum, and they spend more time at minimum than at maximum.

The average deviation of the times of maxima and minima from the derived periods is between seven and eight days; doubtless the major part of the deviations are due to inherent irregularities in the stars themselves. On the other hand, this deviation is, on the average, only about four percent of the mean period, which can not be considered too large a value for long-period variables. It will be noted that the largest deviations prevail when the star is faint and the observations are less frequent.

The average magnitude at maximum is 8.9, and the average range amounts to 4.5 magnitudes.

Of the 100 stars, 26 belong to class A; 15 to class B; and 59 to class C. The C class appears to be the predominant one for long-period variables, especially of Me spectral type. If we further subdivide the three classes, we find that the Aa class includes 7 stars—rise to maximum equal to fall to minimum; 3 are of the Ab class—rise more rapid than fall; and 5 appear to belong to the Ac class—fall slightly more rapid than rise. Eleven of the class A stars present still-stands. For the class B variables, 8 are of the Ba class; 4 are Bb; and 3 are Bd. Among the class C stars, Ca numbers 8; Cb, 42, and Cd, 9. The cases of fall more rapid than rise do not appear to exist for the B and C classes. The preponderance of stars of the Cb class is very striking.



LIGHT CURVES OF LONG-PERIOD VARIABLES—IV

When we separate the Me spectral type stars into their subdivisions, we find that type M1e contains 2 stars; M2e, 5; M3e, 19; M4e, 9; M5e, 10; M6e, 10; M7e, 11; and M8e, 1. For two of the Me stars, no subdivision of classification is available. The M3e variables exceed in number those of any other subdivision.

Subdividing the Se-type stars, we have 3 of S1e; 1 of S2e; 3, S3e; and 3, S4e.

The mean period of all 100 stars, regardless of spectral type, is 322 days. The 69 stars of Me type give a mean period of 277 days; those of the 10 Se-type variables give a mean value of 389 days. Although selection doubtless plays a large part in this disparity in length of period between the Me and Se stars, it has been recognized for some time that, as a rule, Se stars have longer periods

than those of type Me. For the Me stars, 2 have periods between 100 and 149 days; 7 between 150 and 199 days; 9 between 200 and 249 days; 14 between 250 and 299; 15 between 300 and 349; 10 between 350 and 399; 10 between 400 and 449; and one each between 450 and 499, and between 500 to 549.

Correlations between spectral type, range, period, and form of curve, are found to exist; some decidedly strong, others only slightly in evidence. For example, the correlation between Me spectral divisions and increasing length of period has long been recognized; stars of late spectral type have, on the average, the longest periods, a correlation which may be considered almost perfect. A fairly good correlation exists between length of period and width of maximum compared to width of minimum, those stars with the narrowest maxima and widest minima having the longest periods. Also, those stars with the largest range in variation appear to have the broadest maxima compared to their minima, as well as the faintest apparent magnitude at minimum.

The correlations between steepness of rise compared to fall, and width of maximum compared to width of minimum, are fairly good, those stars with the steepest rise having the sharpest maxima and flattest minima.

The above correlations have been based on study of the light curves. More recently, the light curves of these 100 variables have been reduced to intensity curves, and already one can see that the correlations will be somewhat different, but, surprising as it may seem, not materially so. A more detailed discussion of light-curve and intensity-curve correlations will be made when the respective curves for many more of the variables have been derived. *A priori*, one might assume that the study of the intensity curves would give a better physical interpretation of what is happening in these stars than would a study of the light curves.

The A.A.V.S.O. at New Haven, Connecticut: By attending sessions of the 68th meeting of the American Astronomical Society in New Haven this past June, and by the meeting of the Council on June 13 to conduct necessary business, members of the A.A.V.S.O. helped preserve the continuity of the Association's meetings, at least for a while longer.

While some of the members present were professional astronomers who would no doubt have journeyed to New Haven anyway, in addition a number of amateurs from nearby were present. Several of the papers at the meeting dealt directly with variable stars in one way or another. First among these was the paper prepared by the Recorder discussing the 70-foot plot of the 45-year records of SS Cygni, which was on exhibition in the lecture hall.

Miss Margaret Harwood, of the Maria Mitchell Observatory, further discussed variables in the Scutum cloud, and Miss Frances W. Wright, Harvard, spoke on eleven variables in the globular cluster, N.G.C. 4833.

Council members and a few guests met at the home of Councillor and Mrs. Donald S. Kimball for luncheon, followed by the Council meeting.

At present, it is planned to hold the Fall meeting of the Association as usual at Harvard, probably on the 9th and 10th of October, although the dates have not been definitely settled. It is hoped that an interesting program can be worked out, although, under present conditions, this may be somewhat curtailed compared to the traditional Fall program. Members who will find it impossible to attend this meeting may want to participate by communicating papers to be read at the sessions.

The following observations were received during May and June, 1942:

Name	Var.	Obs.	Var.	Obs.	Name	Var.	Obs.	Var.	Obs.
Ball, A. R.			44	71	Kelly	10	13	9	10
Ball, J., Jr.			6	6	Kerns			5	5
Bappu			35	270	de Kock	64	285	66	275
Blunck	19	21	19	22	Koons	84	96	23	28
Bouton	40	78	34	38	Lovinus			18	28
Buckstaff	7	17	7	16	Manlin	31	40	68	82
Cilley	95	201	80	202	Mason	6	6		
Cousins	32	44			Maupomé	41	46	27	27
Fernald	217	373	154	218	Nadeau	28	48	25	41
Ford			47	50	Parker	39	39	19	19
Garneau	9	9	16	16	Parks	25	47	23	30
Giese			16	16	Peltier	106	170	90	110
Griffin	20	20	7	7	Petzold	9	14		
Halbach			56	67	Rosebrugh	2	3	4	5
Harris	25	25	11	11	de Roy			10	17
Hartmann	124	129	104	114	Schoenke			48	76
Holt	136	222	164	323	Sill	35	35	41	46
Houghton	68	99	84	219	Topham	13	13	13	13
Houston	11	11			Toyek			1	1
Howarth	14	19	18	25	Vohman	30	30	36	36
Huffer	12	16			Webb	13	15	8	11
Jones	58	179	39	58	Weber	15	15	44	44
Kearons, Mrs.	66	111	44	84					
					Totals			1563	2737

May 15, 1942.

Comet Notes

By G. VAN BIESBROECK

After several futile attempts PERIODIC COMET FORBES 1929 II was recovered June 15 by the writer using the 24-inch reflector of the Yerkes Observatory. The comet was quite faint, not brighter than a star of magnitude 14; it showed a fuzzy nucleus with a short tail in a direction opposite to that of the sun. It was found near the position predicted by F. R. Cripps in the *Handbook of the British Astronomical Association:*

1942 June 15.34763 $0^h\ 4^m\ 25^s.11$ —4° 50′ 18″.7 (1942.0)

which indicates that the comet reached perihelion only half a day earlier than predicted.

First discovered on August 3, 1929, by the amateur astronomer A. F. I. Forbes at Rosebank near Capetown, this comet was followed for three months and a discussion of the measures showed that it was a short-period object of the Jupiter family, with a period of 6.38 years. It was not seen in 1935 at its first return to perihelion; the conditions of visibility were unfavorable. This year brought the comet back in its second return to minimum distance from the sun on April 16. But it was not until June that it moved far enough away from the sun to be observed during the night hours. Even so it could then only be recorded for a short time just before the dawn.

The following ephemeris shows that the conditions of visibility improve slightly but the comet will remain a very faint object.

EPHEMERIS OF PERIODIC COMET FORBES 1929 II

1942	α h m	δ ° ′	Distance from Sun	Distance from Earth
Aug. 5	1 1.2	+1 32	1.89	1.19
13	2.5	49		
21	1 1.4	54	1.98	1.15
29	0 58.0	47		
Sept. 6	52.6	32	2.07	1.13
14	45.8	1 9		
22	37.9	0 42	2.16	1.17
30	29.9	+0 15		
Oct. 8	0 22.4	−0 7	2.26	1.27

This ephemeris, supplied by N. Makarov, University of Kasan, U.S.S.R., is practically identical to Scripps' prediction which was not carried beyond July 4. It is fortunate that the orbit secured in 1929 was so accurate that the comet could be found after an interval of 13 years. It now becomes a *bona-fide* new member of the group of periodic comets moving around in the central part of the solar system.

The only other known comet now under observation is PERIODIC COMET GRIGG-SKJELLERUP. It reached a maximum brightness of 10^M in June and was at that time independently picked up by L. Peltier in Delphos, Ohio, who had no knowledge of its presence. It remained very diffuse and inconspicuous although the diameter was as large as 3′ on July 7. It now decreases rapidly in brightness and will probably be too faint for observation by next August.

In the morning sky two more periodic comets are to be looked for; they are COMET WOLF No. 1 and SCHWASSMANN-WACHMANN No. 1 but both will require large telescopes to be seen.

From a delayed communication to the Editor it appears that to the list of independent discoverers of the bright comet 1941 *c* has to be added the name of Dr. H. Subramani Aiyar who measured the position with the 5-inch refractor of the Trivandrum (India) Observatory and even computed the orbit. This information was sent to the Astronomer Royal of England.

Williams Bay, Wisconsin, July 9, 1942.

Notes from Amateurs

Herschel Astronomical Club

The Herschel Astronomical Club closed its seventh season with a meeting on May 22. Mr. Samuel R. Parks, Supervisor of Education in the local public schools and our speaker of the evening, presented for his subject, "Visual Education." Accompanying his talk were two "ERPI Classroom" films: "Exploring the Universe" and "The Solar Family."

The advantages of this method of instruction, especially when explaining the planetary motions, were clearly shown.

Meetings will be resumed in October with Mr. Parks continuing as President for the seventh year.

FRANK J. KELLY, *Secretary.*

Fall River, Massachusetts.

Communications and Comments

Under this heading we shall publish from time to time such material as does not properly fall under any of the established headings of this journal. Here, too, may be found, when occasion arises, articles which the editor may not be willing to give sanction to but which, nevertheless, may be provocative of thought along new lines.

Interesting Changes, Developments, and Structures in Sunspots

(From observations with the telescope)

The sun is like a vast panorama with changes and developments always occurring on its spotted disk. Hardly elsewhere in the heavens is so much interesting change to be found. With extended observations these changes are found to occur according to definite patterns.

New sunspot groups appear as pairs of tiny spots close together then they spread apart as they enlarge. In its prime the regular sunspot group is a wide pair with a round leader spot in the direction of the sun's rotation and a double or irregular follower spot. When it declines the penumbra is the first to shrink away then the nuclei dwindle until a wide pair of tiny umbrae is left. Large faculae displays often mark the scenes of old groups. Some of the largest of these displays marked the decline of the giant sunspots of October 17, 1938, and September 22, 1941. Faculae seem to appear mostly where the solar surface is stirred up by the presence of spots.

Besides the regular type there are other rarer kinds. Isolated sunspots are not commonly found and are usually round and sometimes large. It appears that distortion mostly occurs when several spots are together in a group. There are some groups with dominating follower spots (April 22, 1939) and some with no main nuclei (October 10, 1938) while some others are completely irregular such as the great sunspot groups seen on July 14, 1938, on September 10, 1939, and also on September 19, 1941. In these the bipolar structures were obscured by the irregularity of detail in the usually sparce central regions. These form a contrast to the group of January 6, 1940, which was one of the most nearly perfect ever seen. Another kind is the combined or network group in which all the nuclei are linked together by penumbral extensions into one spot.

Within the groups themselves features of interest are observed. The configurations of the penumbra indicate the development of a group. In its prime the penumbra spreads out in complex tentacles or filaments which later dwindle into rounded club-like extensions which finally disappear. This has been noticed in a great group on October 9-10, 1938. A very fine example of a penumbral network was seen on September 17-18, 1941. In many typical groups is to be found a "S" curved stream of small central spots looping around the two main spots showing the cyclonic relationship between them. On May 23, 1938, and on March 1, 1942, examples of this type were seen. When groups decline the central stream is the first to go.

Many large spots often split into double nuclei within the same penumbrae like that of November 10, 1938. As a whole the groups have been found to grow faster than they decline and some even grow out almost overnight like the one which popped out on May 23, 1938. Sometimes penumbral smudges or veils are seen among the other umbrae, without nuclei. What is perhaps a rare phenomenon

was observed on June 6, 1941, in the form of a hollow ring-like penumbra containing several umbrae. Faculae are seen to form parallel serpentine streaks.

It is interesting to notice the relation between solar spots and earthly phenomena for when the spot crosses the center of the solar disk its radiations are aimed at the earth. This happens mostly in March and September. The solar spots of March 24, 1940, and September 18, 1941, were observed previous to the severe magnetic storms and aurorae (seen in Chicago) of those dates.

All of these features were observed in the greatest sunspot cycle since 1870 which also contained the greatest solar prominence and most intense magnetic storm of modern times.

LESTER SUSSMAN.

1411 S. Sawyer Avenue, Chicago, Illinois.

General Notes

Dr. William H. Wright, professor of astronomy and director of the Lick Observatory will retire from active duties at the end of the current academic year. (*Science,* May 29, 1942.)

James G. Baker, of Harvard College Observatory, has been awarded the Adolph Lomb Medal for 1942 by the Optical Society of America for perfecting the famous Schmidt camera to the point where it virtually quintuples the seeing power of a telescope, and for other contributions to astronomical optics. The medal, awarded biennially for noteworthy contributions to optics, will be presented at the annual meeting of the Society next October. (*Science News Letter,* May 30, 1942.)

Dr. A. B. Wyse of the Lick Observatory has become the first casualty of the war in astronomical circles. According to newspaper reports Dr. Wyse was a member of an experimental mission involving two Navy blimps which left Lakehurst, New Jersey, on the evening of June 8. Apparently the airships collided and all but one of the crew were lost in the ocean. Dr. Wyse had been at the Lick Observatory since 1935 and was widely known for his studies of eclipsing stars, novae, and nebulae. During the past year he has been engaged in defense work in San Diego.

Reverend T. E. R. Phillips, upon whom the degree of D. Sc., *honoris causa,* was conferred by Oxford University on February 28, died on May 13 at the age of 74. Dr. Phillips was an amateur who did work worthy of a professional. In *Nature* for May 30, 1942, we find the following appreciative paragraph:

"Phillips' genial disposition made him very popular in astronomical circles, where he will be greatly missed. During his illness many anxious inquiries were made about his progress and there were hopes that he might rally and attend the meetings again, but early in May it was known that his condition was extremely grave, and he died on May 13. The interment took place at Headley on May 16, when a number of astronomical and other friends were present. In 1906 he had married M. H. Kynaston, who, with a son survives him."

De Revolutionibus to be Republished

In connection with the 400th anniversary of the publication of De Revolutionibus by Nicolas Copernicus in 1543, there has been formed the Copernicus Society at 459 East 133rd Street, in New York. The object of the Society will be the publication of the first English translation of this classic in the history of science.

The translator selected is Dr. Edward Rosen, a graduate of Columbia University and a member of the Department of History at the College of the City of New York. Dr. Rosen is the author of "Three Copernican Treatises," comprising the first English edition of the minor astronomical works of Copernicus including the Commentariolus and the Letter Against Werner, as well as the Narratio Prima. The latter work was the first presentation of the Copernican astronomy to an expectant world and was issued from Danzig three years before the publication of De Revolutionibus. Dr. Rosen is at present working under a fellowship of the Guggenheim Memorial Foundation. It is expected that the work of translation will be completed by this outstanding American Copernican scholar in time for the celebration in 1943. Because the year 1543 marked the publication not only of De Revolutionibus but also of De Humani Corporis Fabrica by the young anatomist, Vesalius, it is regarded as the date when the era of modern science began.

The Astronomers of the Simeis (Crimea) Observatory

Extract from a letter received June 8 addressed by Prof. G. Neujmin to an American Colleague under date January 28, 1942.

"The menace of the invasion of the Nazi-hordes has obliged us to leave our dear Simeis Observatory about the middle of October, 1941. The last observations made there were dated September 23.

"Our spectroscopists (Mr. and Mrs. Shajn, Mr. W. Albitgky and Miss W. Hase) went to the astronomical station at Abastumani (Caucasus) while we landed at Kitab in Central Asia after a long and difficult trip. The International Latitude Station, named after the famous Ulugh Bey, is located there. We have here only modest opportunities. Aside from the instruments for latitude there is here the short-focus Bredichin astrograph from the Poulkova Observatory with which I am undertaking the work on asteroids and comets, awaiting that the camera of the Malzoff astrograph which I brought from Simeis can be mounted. Unfortunately our work is handicapped by the meagerness of our photographic supplies and by the absence of scientific literature."

Misquotation

The original source of the misquoted passage is "The First Principles of Geography and Astronomy" by I. Watts, D. D., first published in 1725. The author is the great hymn writer who lived from 1674 to 1748. I have consulted the eighth edition of this work, published in 1772, but cite from the seven volume edition of "The Works of the Rev. Isaac Watts, D. D.," published in 1800. There is a slight difference in punctuation from the afore-mentioned eighth edition. The passage, found on page 402 of volume 6, is as follows:

"These signs are certain *constellations* or numbers of stars which are reduced by the fancy of men for distinction sake into the form of twelve animals, and

for the use of the English reader may be described thus.

The Ram, *the* Bull, *the heavenly* Twins,
And next the Crab, *the* Lion *shines,*
The Virgin, *and the* Scales.
The Scorpion, Archer, *and* Sea-Goat,
The Man *that holds the* Water-pot,
And Fish *with glittering Tails.*"

The part which is in verse I have found cited in 13 astronomical books. I could probably find more citations without great effort. Even overlooking differences in capitalization, hyphenating, indentation, italicization, and punctuation, the passage is not correctly quoted in any one of these although each line of it is correctly quoted in at least three places. Three books agree in one version, two of the books having the same author, who clearly copied from the third, but the three are distinct as to capitalization, etc. Another group of three agree as to words but are distinct as to capitalization, etc. In another case two books by the same author differ as to words. Considering words only there are 9 different versions. No two of the 13 are entirely identical. None of these books cites the source and only one names Dr. Watts as the author.

If we make a composite of the work of the worst of these multilators, we get:

The Ram and Bull lead off the line,
Next Twins and Crab and Lion shine,
The Virgin and the Scales;
Scorpion, Archer, and He Goat,
The Man who pours the Water out,
The Fish with shining scales.

The third line for some reason, perhaps out of deference for the young lady, has remained intact, except as to punctuation. She may have befuddled Dr. Watts so that he counted the Scales as an animal. One writer alters "shines" to "stands." The words Ram, Bull, etc., could hardly be changed but "Sea-Goat" has become "He-Goat" or simply "the Goat" and "Water-pot" has become "watering pot" or, as in the line given, the pot has been discarded altogether. The first "The" of the first and fifth lines, the "and" of the fourth line and "with" in the last line are the only other words open to attack. The improvisers have done a thorough job and they had better call it a day.

SAMUEL G. BARTON.

Flower Observatory, University of Pennsylvania, June 3, 1942.

Book Reviews

Essentials of Astronomy, by John Charles Duncan. (Harper and Brothers, New York City. $1.85.)

In the preface to this short text of about 160 pages, the author, an experienced teacher of astronomy, gives, as one of his purposes, "to develop the subject, more nearly than has been done before, in the order in which the student's interest is naturally awakened". Accordingly, in the first (and longest) chapter, entitled "The Appearance of the Sky," phenomena are set forth which may be supposed to have come to attention through watching the sky for a night, a month,

a year, a life-time, or thousands of years. Here are such diverse matters as the late September constellations; motions of the Moon, Sun, and planets; precession and proper motions; the Galaxy, zodiacal light, meteors, and aurora. Combined with the fact that the first four sentences of the book summarize the present "picture disclosed by astronomical discovery and investigation," this method of approach gives a desirable sense of seeing the end from the beginning.

To many of the subjects introduced in Chapter 1, return is made in the next, called "Appearances Interpreted." The following chapters on "Gravitation" and "Light" present fundamentals in simple language. The truth of the law of gravitation and the "light that it sheds on the workings of nature" are noted as among "the priceless possessions of human civilization". The nature, properties, and effects of radiation with the principles of reflection, refraction, and dispersion provide the basis for explaining the action of curved mirrors and lenses in the essential astronomical instrument.

The discussion of the eight planets in as many pages (including illustrations), as found in the chapter on "The Sun's Attendants," leads one to comment on the other of the author's purposes given in his preface: "to provide a comprehensive textbook of the science of the stars for use in courses that must be completed in a shorter time than the usual college year." It is the reviewer's experience that college students find much greater satisfaction in a text which outruns their immediate need than in one that falls appreciably short. This brief text, clear and interesting as it is, can be read through in a few hours. It would seem to be admirably adapted to the layman's use or to the astronomical portion of a course which aims to include several physical sciences. In a college course in astronomy, its use would involve extensive reading in supplementary texts.

Two remaining chapters, "The Sun and Other Stars" and "Structure and Action in the Universe," touch on many points regarding distances and physical characteristics of stars, binary systems, variable stars, galactic star clusters, and nebulae, the galactic system, the motions of stars and solar system, and external galaxies.

Errors detected are few: on page 67, "area ABCD" should read "area SBCD"; on page 87, instead of "$\angle$AXB," read "$\angle$aXb"; on page 55, it would seem that the Earth's radius vector and the line of the Moon's nodes would nearly coincide *twice* every 346 days. In Appendix 6, satellites VI and VII of Jupiter are listed as of retrograde revolution (contrary to the evidence of Figure 56, where VIII and IX share this attribute with X).

"Optical funnel" is a happy phrase for a concave mirror or convex lens that "pours the light of a beam the size of its aperture into a minute image." It is a good idea to include the invisible ultra-violet lines in the description of Class B spectra, and to choose from the *same* system (Castor) illustrations of the orbit of the visual binary and the velocity curves of spectroscopic binaries. As evidences of modernity, so to speak, Jupiter's latest-found satellites are well assimilated; one finds allusions to carbon as catalyst in the process producing stellar radiation, and to the spectroheliokinematograph (prize-winning as to word length); and there is a cautious statement possibly attributing the coronal lines to highly ionized atoms, chiefly iron.

Contributing to the general attractiveness of this volume is the frontispiece which is a kodachrome of the region of Orion, made at the Whitin Observatory. Also worthy of special mention are the full-page Lick Observatory photographs

(placed opposite each other) of the Moon at first and last quarters, and a photograph of Finsler's Comet of 1937 made with the 18-inch Schmidt camera on Mount Palomar. The latter shows a tail so long as to be cut off by the edge of the field, yet the stars (which include Mizar and Alcor) show scarcely any trailing.

Following the text is a collection of fourteen convenient and useful appendices, eight star maps reprinted from the author's "Astronomy" (third edition, 1935), and an index. Appendix 12 includes, along with up-to-date lists of large reflecting and refracting telescopes, a group of eleven "Astrographic Cameras and Photographic Telescopes of Wide Field". Imaginative, as regards usefulness, is the selection of items for Appendix 14, "Constants". Here are workaday items such as the relation between a kilometer and a mile, an Angstrom unit and a centimeter, and the value of π, as well as the more grandiose concepts regarding the mass and period of rotation of the galactic system, with many others.

Among the good points of these already well-known white-on-blue star maps may be named the presence of a south circumpolar map, the galactic circle with longitudes, an inset giving names of the individual Pleiades, and the running of the equatorial maps to a declination of $\pm 60°$, with such generous overlapping in right ascension that no constellation figure is seriously mutilated.

ALICE H. FARNSWORTH.

Annals of the Astrophyiscal Observatory of the Smithsonian Institution, Vol 6. By C. G. Abbot, L. B. Aldrich, and W. H. Hoover, 1942.

Variable stars are only a minute fraction of the whole number of stars in the sky. The stability of normal stellar radiation has been demonstrated by the extensive photometric studies of more than half a century. The sun, which admits of detailed investigations quite impossible in other stars, showed a total observational range of only one percent in total radiation from 1924 to 1940 and two percent in the preceding 4 years according to results presented in the *Annals of the Astrophyiscal Observatory of the Smithsonian Institution*, Vol. **6**, which was recently issued. This volume which is devoted to the discussion of the methods used and results obtained in the daily measurement of solar radiation at three stations operated under the auspices of the Observatory during the 20 years preceding 1940 is a reservoir of information which every student of solar radiation will read with interest.

Two discussions of errors of measurement will be of more than passing interest. These involve the personal equation of pyrheliometer readings which may amount to nearly 0.5 per cent for observations prior to 1936 and corrections to such readings primarily because of changes in specific heat of the materials of the instrument as a function of temperature. One of the improvements in solar radiation measurement is due to the adoption since 1936 of an improved form of the Angstrom pyrheliometer as the observing instrument. Because of its more rapid action this instrument reduces accidental error; it also practically eliminates personal equation. One great advantage seems to be that it is compensated against the sky radiation for which the silver-disk pyrheliometer observations had to be corrected.

An extensive table gives two or three determinations of the daily solar radiation from each station with the principal reduction factors. The measures at

Montezuma, Chile, run throughout the series, those at Table Mountain (near Mt. Wilson) begin in 1926 and those at Mt. St. Katherine (near Mt. Sinai in Egypt) begin in 1934. The several determinations of the solar constant at a given station on a given day usually agree very well, and, while agreement between stations is often good, considerable departures even in the second decimal are not uncommon. This is not surprising in view of the difficult nature of the problem, for even a laboratory attempt to determine the amount of radiation to an accuracy of less than one per cent is accompanied by a multitude of difficulties. The authors suggest therefore that the tables for one station be used consistently in discussing correlations with other phenomena.

The table also gives "preferred" and "improved preferred" solar constants for each day and these are the data which are used in the discussions of periodicity which make up the final chapters of the volume. The corrections which produce these values might be described as a sort of personal treatment given to each day's results. The greatest uncertainty arises from the pyrheliometer. If the variations it indicates are real and particularly if they result from solar temperature changes the differences in the violet will be much greater than those in the infrared. The authors then go back to the bolograms from which the ordinates at 6 points in the visible and ultraviolet regions are then measured and expressed in terms of those of two points in the infrared. Any variations in these measures are regarded as measures of the variability of the temperature of the sun and therefore of the solar constant. If these ordinates in the spectrum so standardized against the infrared increase and decrease with the solar constant it is regarded as a reliability indicator, but if the reverse situation exists the solar constant must be adjusted to "preferred" values which will explain the bolograms taken on that day. No doubt the idea of using the bolograms *per se* to determine the variations of the solar constant has been considered by the authors, but it is not discussed here.

"Besides this spectral distribution as an indicator of probable values, the continuity of trends from day to day was much relied upon." The results from the various stations were also weighted according to their average accuracy. However, there is danger that by these methods artificial variations which the observations do not warrant may be introduced and the results may begin to suffer from *over computation* which would greatly lessen the value of such an extensive piece of work.

The ten-day means as well as the monthly averages of the ten-day means of the observed and "preferred" solar constants are tabulated and the march of the "preferred" monthly averages is plotted. The considerable depression in the curve in 1922-3 unfortunately coincides with an interval of reduced observational effort which the authors frankly point out.

The solar constant material itself shows no evidence of the ordinary sunspot period which *averages* 11⅓ years. The reversal of the magnetic polarities of sunspots and the alternate high and low cycles of spottedness give some reason, possibly remote, to suppose that the real sunspot cycle is double the ordinary cycle, *i.e.*, 22⅔ years or 273 months on the average. While the solar constant data do not cover an interval long enough to show the presence of this 273 month period, nevertheless it is made the fundamental from which shorter periods which are aliquot parts (harmonics) of the fundamental are sought. It should be pointed out in this connection that the intervals between the past three sunspot minima

have been 10.0 and 10.2 years, respectively, making the double period about 240 instead of 273 months.[1] A final table details the fundamental 273 month period and a dozen harmonics. It also gives the synthesized sum and the departures of this sum from the original "preferred" values plus a constant. A plot of the synthesized values is shown together with that of the "preferred" solar constant and it is extended to December, 1945, where it reflects the depression of 1922-3. This prediction will, of course, be the test of the 273-month period and its principal harmonics.

Two plots bring out the evidence for a 27-day or solar rotation period. The analysis of the varying values of the solar radiation thus leads to a total of 14 distinct periods ranging from 8⅛ to 273 months.

EDISON PETTIT.

Carnegie Institution of Washington, Mount Wilson Observatory, June, 1942.

[1] *Astronomische Mitteilungen*, **132**, p. 67, 1935.

Publications Received.—The publishers of POPULAR ASTRONOMY hereby acknowledge the receipt of the following named publications and express their great appreciation of the courtesy shown on the part of those who have sent them.

Contributions from the Mount Wilson Observatory:

Nos. 652 and 653. "The Photographic Determination of Stellar Parallaxes with the 60- and 100-inch Reflectors. Eighteenth Series," and "Investigations on Proper Motion. XXII. Faint Members of the Pleiades Cluster," by Adriaan van Maanen.

No. 654. "A Spectrographic Study of the Eclipsing Variable Star, WW Draconis," by Alfred H. Joy.

Nos. 655 and 656. "Absolute *f*-Values for Lines of *Fe* 1," "Abundance of Iron in the Sun," by Robert B. King.

No. 657. "Spectra of Planetary Nebulae of Low Surface Brightness," by R. Minkowski.

No. 658. "Mean Absolute Magnitudes and Space Motions of the Long-Period Variable Stars," by Ralph E. Wilson and Paul W. Merrill.

POPULAR ASTRONOMY

CONTENTS

AUGUST, 1942

THE SIXTY-EIGHTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY, WITH PLATE II, DEAN B. MCLAUGHLIN 349

REPORT OF THE CONFERENCE OF TEACHERS OF ASTRONOMY AT NEW HAVEN, CONNECTICUT, JUNE 12, 1942, MARJORIE WILLIAMS 353

REPORT PREPARED BY THE COMMITTEE OF THE AMERICAN ASTRONOMICAL SOCIETY ON PREFERRED SPELLINGS AND PRONUNCIATIONS 356

THE METEORITIC ORIGIN OF LUNAR CRATERS, WITH PLATE III, RALPH B. BALDWIN 356

DEMONSTRATION EQUIPMENT FOR EFFECTIVE TEACHING IN ASTRONOMY, ROBERT L. PRICE 369

MARVELOUS VOYAGES—IV, LAURENCE J. LAFLEUR 377

Planet Notes for September and October, 1942 379

Asteroid Notes 381

Occultation Predictions for September and October, 1942 382

Meteors and Meteorites 383

Meteor Notes from the American Meteor Society,—Contributions of the Society for Research on Meteorites: The aerolitic fall of Rancho de la Presa, Zenapecuaro, Michoacan, Mexico; The compressive strength of meteorites; "Long-enduring Meteor Trains" (Review),—An extraordinarily large meteor seen in Texas, June 17, 1942.

Variable Stars 392

Variable Star Notes from the American Association of Variable Star Observers.

Comet Notes 396

Periodic comet Forbes 1929 II,—Periodic comet Grigg-Skjellerup,—Comet Wolf No. 1,—Comet Schwassmann-Wachmann No. 1.

Notes from Amateurs 397

Herschel Astronomical Club.

Communications and Comments 398

Interesting changes, developments, and structures in sunspots.

General Notes 399

Personal notices,—De Revolutionibus to be republished,—The Astronomers of the Simeis Observatory,—Misquotation.

Book Reviews 401

Essentials of Astronomy,—Annals of the Astrophysical Observatory of the Smithsonian Institution, Vol. 6,—Publications received.

The principal articles of this magazine, beginning with Volume 15 (1907), are listed in the INTERNATIONAL INDEX TO PERIODICALS.

Y

349

353

356

356

369
377
379
381
382
383

92

96

97

98

99

01